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Network Administration for the 1990s

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SPECIAL ISSUE—NETWORK ADMINISTRATION FOR THE 1990s

The Board of Editors is grateful to Alan Bealby, General Manager Network Operations Support, BTUK, who commissioned this special issue of the *Journal*, and to Jeff Peacock, Dave Trent, Ken Brook, Ian Harper, Tim Jeanes, Steve Cooper, and the Network Administration Implementation Programme Management Group for their help in its preparation.

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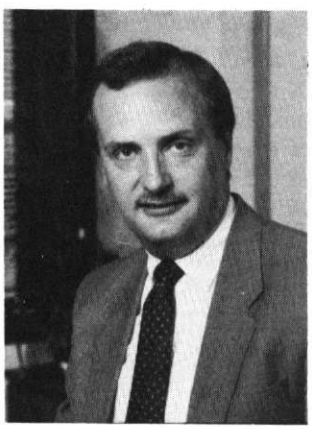


FOREWORD by Chris Earnshaw

The effective and efficient operation of British Telecom's UK network is a vital component of BT's plans to offer customers world-class telecommunications services. The Network Administration Implementation Programme (NAIP) is set to improve radically the way in which BT manages and operates the network.

I am pleased to contribute to this special NAIP issue of the IBTE *Journal* which records some of the key aspects of this complex programme.

The foundation for NAIP was the work of the Network Administration Task Force (NATF) which presented recommendations in 1987 for the administration of BT's UK network in the 1990s. In particular, the Task Force recognised the opportunities for harnessing the capabilities of modern digital network systems, advanced computer control and management systems, and the best operational practices across the company.

The NAIP programme has involved many professional staff in different parts of British Telecom, both those in operational roles in Districts and Regions as well as those responsible at the centre for policy and systems specification and development, to create a comprehensive plan for the progressive implementation of the programme.

Fundamental to the plan are the network operations units (NOUs) which allow fast and efficient control of network operations. The decision to implement two early NOU pilot sites, at Manchester and Walsall, has enabled the early plans and systems to be evaluated prior to roll-out of the remaining programme. The pilots have also served as a valuable focus for refining existing practices. Indeed, it is the adoption of these practices, many of which have already been developed in different Districts, that has enabled the programme to progress at such pace.

NAIP is not just about systems and technology. It is also very much about the people who operate and support the network. An important part of the programme is the positive management of these changes. The successful implementation of changes of this scale is dependent on the partnerships between all the parties involved. As NAIP has progressed, these partnerships have developed substantially to facilitate a more rapid evolution than might have been possible in earlier years.

The next 12 months will see the transition from two pilots to full implementation of the NOUs. The substantial investment in this programme will complement the investments BT has made in recent years in modern network systems. Although the changes and improved effectiveness will be substantial, there are many further opportunities to improve the network to deliver the quality and costs customers now expect. The first phase of investment provides a substantial platform on which Worldwide Networks will continue to build throughout the 1990s. Indeed the successful implementation of NAIP is a key enabler to the style of operations that Project Sovereign seeks to deliver.

C. M. EARNSHAW
Director Network, British Telecom UK

The Development of Network Administration in British Telecom

A. G. BEALBY†

Under its network administration strategy, BT is radically restructuring the management of its UK telecommunications network to exploit fully its investment in modernisation. This article reviews the structure and its implementation, and the benefits that will accrue in terms of reduced cost of ownership and responsiveness to customer demands.

INTRODUCTION

Until the start of the 1970s, analogue technology was the backbone of the telecommunications network.

Maintenance of this network was characterised by responding to reported faults and alarms, which involved a high level of manpower. This manpower was necessary not only to get to and clear any difficulties, but also to register that there was a problem in the first place and to decide what needed to be done. The work was highly distributed with little correlation of faults and hence little co-ordination of field activity.

Even the emergence of digital transmission with the introduction of pulse-code modulation (PCM) had given little scope to change how the telecommunications network was maintained. The major breakthrough came, however, with the advent of computer technology in both the transmission and switching arenas. This embedded network intelligence has opened up vast horizons for innovation and created substantial opportunities for reducing cost and improving customer service, unthinkable as recently as 15 years ago.

This article places these opportunities in perspective and outlines how British Telecom is exploiting them to the full in order to achieve its goal of having the best managed and administered telecommunications network in the world.

OPERATIONS AND MAINTENANCE CENTRE (OMC)

When a viable digital switching product emerged in the mid-1970s to complement the economy and quality characteristics of digital transmission, telecommunication companies around the world concentrated on improving the quality of service and the level of functionality available to customers. Improved maintenance features also emerged, allowing a step improvement in centralised cost-reduced maintenance.

The opportunities in the operations and maintenance field were recognised very early on by British Telecom. It developed the operations and maintenance centre (OMC) which came into service with the first System X exchanges in 1985. From the outset, the OMC not only provided centralised remote surveillance and engineering interaction with the System X exchanges, but also allowed remote non-technical staff to interact with the administration of the exchange. Sales people, for example, could provide/change customer services and, similarly, billing people could interrogate billing information. The OMC was, therefore, the first important building block in bringing about fundamental improvements in network administration, operations and maintenance.

OFF-LINE SUPPORT SYSTEMS

The OMC provided on-line links into the System X exchange. This facility was rapidly extended to AXE10 in 1986 on its introduction into the BT network. Although data building and in-service management tools were a prerequisite to digital modernisation, only basic support tools were available. However, there was an increasing demand from field managers to have tools and procedures to interpret fault and performance information output from transmission equipment and exchanges. The field managers also required to manage and rectify faults, to interface with other support systems, and to link efficiently into other network operating functions. It was clear, therefore, that to meet field managers' requirements and to ensure full exploitation of the capital investment in both switching and transmission equipment, BT required to undertake a major review of network operations, with a focus on network surveillance, management, operations and maintenance. The functions were collectively referred to as *network administration*, and this major review was undertaken in 1987 in the form of the Network Administration Task Force (NATF) study.

† Network Operations Support, British Telecom UK

THE CUSTOMER AND NETWORK ADMINISTRATION

Before describing the work of the Task Force, it is worth emphasising the central role that customers' demands play in creating the imperative for change in network operations, in addition to the cost driver.

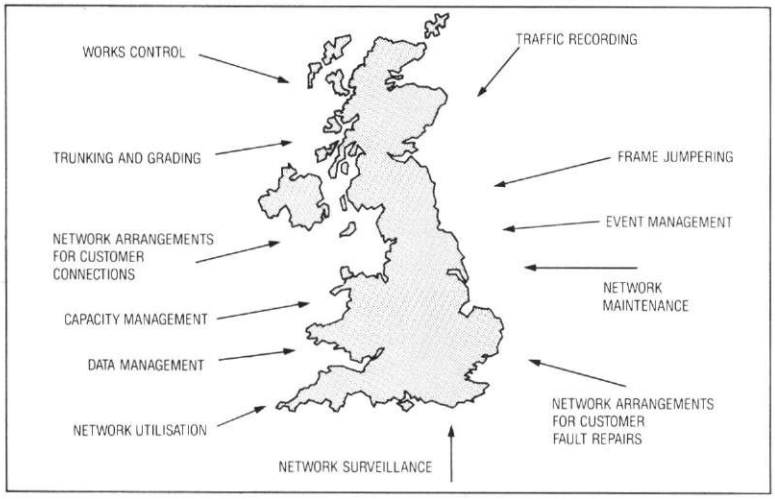


Figure 1—Network administration functions

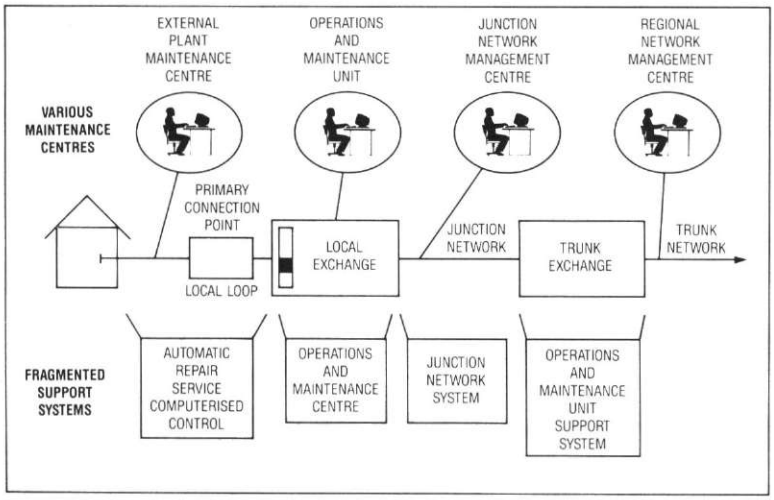


Figure 2—Operations—fragmented approach

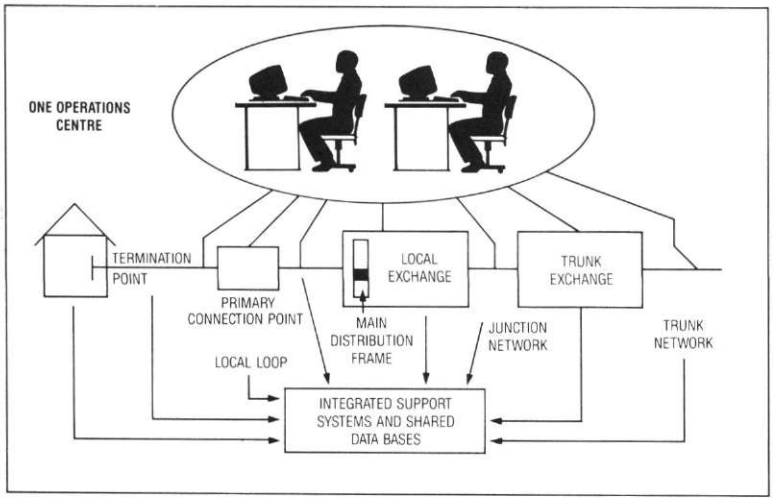


Figure 3—Operations—integrated approach

The customer rightly demands:

- quality transmission all the time;
- competitive pricing and value for money;
- a prompt, guaranteed repair service when things go wrong; and
- functionality to meet needs as specified, on time, every time.

These needs are in part met by the introduction of modern switching and transmission equipment into the network. However, at least as important in meeting the customers' requirements is to put in place a fully integrated infrastructure to administer and exploit the modern network equipment. Automated correlation of faults and alarms, automated diagnostics to decide the solution, and automated allocation of the necessary remedial action to the most appropriate person, go a significant way towards giving customers what they want by way of quality and service.

In fact, the modern network with the network administration infrastructure BT is currently putting into place will increasingly differentiate BT's products and services from those of competitors and provide the high-quality services the customers demand. When problems do arise the speed of response and actions taken will in many instances mean that the problem is resolved in such a way that there is no loss of service to the customer.

NETWORK ADMINISTRATION TASK FORCE (NATF)

The NATF team was essentially a blend of field and head office managers. The team initially concentrated on assessing the scope to centralise operations and maintenance activities. However, the interdependency in a 'hands off' digital environment of not just the operations and maintenance function, but all administration functions, rapidly became clear. The range of functions which had to be considered is illustrated in Figure 1 and includes works control and capacity management as well as surveillance and data management. An integrated and standard approach to network administration was required. The traditional more fragmented approach shown in Figure 2 had to be replaced by the vision illustrated in Figure 3.

NETWORK ADMINISTRATION STRATEGY

The Task Force report contained over 100 recommendations to the BT Management Board. The recommendations centred on the need to undertake a major restructuring of how the network was administered to gain economies of scale in reducing costs and delivering quality. The existing proliferation of control centres spread over 28 geographic local Districts and 10 Trunk Regions would be reduced to about 12 network operations units (NOUs), each capable

of administering a catchment area equivalent to around 4 million lines.

In attaining the vision there would be a clear separation of network control activity, which would be solely undertaken in the NOUs, from the physical execution of work activity in the field. The complete three-tier network administration hierarchy is illustrated in Figure 4.

Network field staff would operate within network field units (NFUs). There would be about 50 of these throughout the country. The management of the network would be carried out in the 12 NOUs, where teams of network administration experts would control activities for their own catchment areas. Operations that required a national picture, for example, network traffic management, would be located in the central operations unit (COU).

These three operational tiers would be supported by 10 network administration computer centres (NACCs). Dedicated and integrated computer systems would facilitate the real-time management of network traffic, real-time surveillance of transmission, and remote provision and repair at any point on the network. All new computer systems would be network based, thus removing the distinction caused by internal organisational divisions such as local and trunk. They would be designed to dovetail with customer-facing systems, such as Customer Services System (CSS), and to maximise the potential for reconfiguration of the network to meet customer needs.

An important element of the vision was a network operations support unit (NOSU), which would provide all necessary policy and support systems. Ownership of all network operations processes would be vested with this unit, and improvement and developments would be seeded and progressed in close partnership with field managers.

Finally, the strategy recognised the need to be able to integrate the advantages of the customers' own computer applications with the capabilities of the network. There was a need to pull together the growing proliferation of customers' and proprietary support systems into a unified set of coherent integrated systems. To this end, BT is vigorously pursuing the approach of the internationally agreed open network architecture (ONA) standards.

IMPLEMENTATION OF THE NETWORK ADMINISTRATION STRATEGY

A major programme, the Network Administration Implementation Programme (NAIP), is currently in place to develop and implement the NATF recommended network administration hierarchy and to provide the platform to allow evolutionary improvement. The central operations unit (COU) is already in place and the initial programme *Platform build* has been fully justified on a cost/benefit basis, and has been authorised by the BT Management Board.

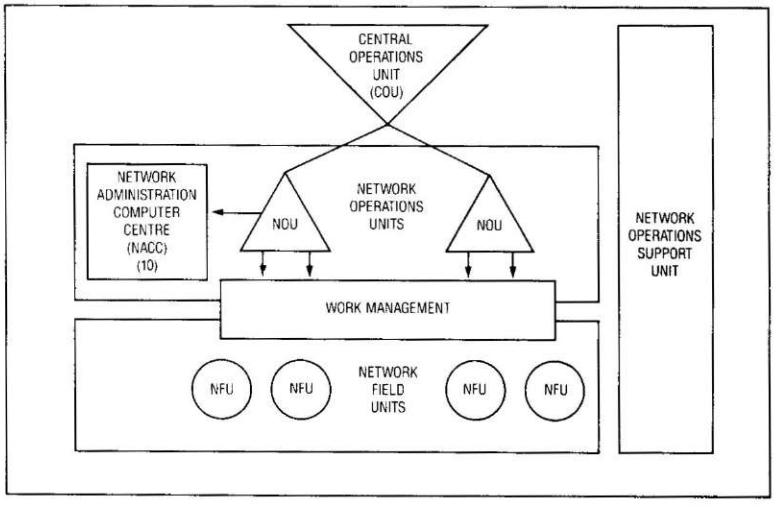


Figure 4 Network administration structure

It has been decided that the functional elements of this Platform should centre on the creation of nine NOUs (not 12) with controls for switching and transmission surveillance, operations and maintenance. Two of the nine NOUs, in the North West and Midlands, are currently in operation, piloting and proving standard systems and procedures. The remaining NOUs will be established by mid-1991. More details of the Platform build are shown in Table 1.

TABLE 1
NAIP Platform

TXD Standard Practice
Trunk—Transfer OMUs to NOU
Local—Merge OMUs at NOU
Merge trunk/local support groups
TXE4 Standard Practice
Establish centralised maintenance
Transmission Standard Practice
Consolidate surveillance and control at NOU
Power and Building Services Standard Practice
Establish power maintenance controls
Network Control Centre Standard Practice
Introduce integrated network control at NOU
Integrated Network Performance Management
Common task allocation and control duty

The major impact of the Platform build will be in the operations and support centre (OSC) area of the NOU. Here, the maintenance controls for the whole of the modern network in the NOU catchment area will be brought together into a single location. This will involve the local and trunk operations and maintenance units (OMUs), together with the trunk regional network management centre (RNMC). A number of network surveillance systems such as digital equipment alarms, transmission systems

monitoring, and alarms for power and building engineering services, will also be brought together. This will necessitate the provision of new support systems to enable the various monitoring facilities to be merged. One particular system is the network operations management system (NOMS1) which will permit concentration of exchange alarms onto a single screen, and facilitate access to remote administration tools. NOMS2 will provide a level of control for tasks dealt with by the maintenance field force including out-of-hours activities. TXE4 exchanges form part of the modern network, and a range of facilities to allow their remote administration will also be provided. A further significant aspect is the proposal to amalgamate trunk and local 24-hour staffing rotas. Technical support groups within the NOU catchment area will also be brought together under control of the NOU.

Outside the OSC area of the NOU, other features of the Platform build include the introduction of a 'standard practice' performance measurement system. This will be based on the measurement and analysis centre (MAC) and exchange performance information collection (EPIC) systems. There will also be functions to support the interface between the network and its customers, such as fault handling procedures, definition of performance levels and the establishment of procedures to allow effective use of line test systems by customer-facing staff. The customer-facing organisation will be supported by a 'help desk' contained within the NOU.

The computer power required to drive all the support systems in the NOUs is now in place at 10 NACC sites. The Network Computer Architecture Board (NCAB) is also well established to manage the evolution and integration of all operations and planning support systems towards a common ONA standard.

The Platform is seen as a vitally important next step in the evolution of the BT network. The standard systems and procedures chosen have been identified from existing practices as good, sound and robust, but with the important additional ingredient of evolutionary capability.

NAIP AND THE PEOPLE INVOLVED

In its simplest view, the implementation of the network administration platform is about identifying existing best practices, making some improvements and defining them as a national standard. The teams can then be established in the NOUs, and these standard practices implemented. This simple view of NAIP would be a gross underestimation and misrepresentation of the size of the task BT has undertaken.

BT has, over the past five years, become a world leader in network modernisation. There has been a single-minded drive by field managers to meet modernisation targets. BT has now off-loaded all of its analogue trunk traffic onto the digital network; it has the most modern, quality trunk network in the world. BT currently has over 10 million digital customer lines in service, plus some 7 million modern analogue SPC customer lines on TXE4, and last year alone converted 4·6 million customer lines from analogue to digital switching. This has only been achieved by the tremendous commitment, skills and dedication of its workforce, who, five years ago, had no in-service experience of digital equipment and who are now as experienced as the world's best.

Given this fantastic network achievement and success, BT, in making the change to administer its network from nine centres to meet business and customer objectives, is embarking on a project where the management of change is a major challenge. It is a necessary change which must be made to continue BT's success. There is an important need, therefore, to communicate and explain the impetus for the change to these very successful modernisation teams; to consult field managers and their people in specifying evolving requirements; and to decide jointly with field managers what practices and systems to define as the standard on which to build. To explain the vital need for a transfer to one standard methodology across the network is itself an important task.

So, people are the key to the successful creation of the new network administration methodologies and BT is mindful and respectful of the effects change can have on people in creating the new network administration infrastructure.

NAIP AND EQUIPMENT SUPPLIERS

The centralising of operations onto nine NOUs opens up the opportunity for BT to form new relationships with its suppliers in supporting equipment after it is brought into service.

To ensure timely evolution of network equipment in order to reduce total cost of ownership and early life cost of failures, suppliers must get close to their products in service. No longer can suppliers of sophisticated network equipment be considered to be solely manufacturers. In an age of ever-increasing reliability, functionality and complexity, the equipment suppliers must not only supply, but stay close to their products in service. Suppliers must feel whatever 'failure' pain there might be when their products are brought into service. They must have direct experience of their products in service and have a direct incentive to improve installation techniques, in-service diagnostics and equipment, and support systems, with the overall objective of reducing costs and improving quality for BT.

The creation of standard practices and procedures centred on as few as nine operations centres facilitates such opportunities, and is giving an impetus to BT and its suppliers to explore them. An overriding prerequisite for such a change in relationships with BT's suppliers, however, is that there is a sound business

case. Further, both the technical and commercial framework within which any agreement is made, must ensure a reducing trend in total cost of ownership and increasing quality of equipment, and lead to increasing responsiveness to customer demands for features and facilities.

FURTHER OPPORTUNITIES

Implementation of the Platform build to reduce operating costs and better serve customers is the first important step on the evolutionary path of added improvement and functions in the field of network administration. As modernisation progresses and increasingly intelligence is embedded throughout the network, the opportunity to build effectively and efficiently on the Platform to reduce costs, and to facilitate the easy introduction of new services, is immense.

The functions to benefit are those that were shown in Figure 1 and range from seeking improvements in capacity management to works control. The improved administration structure will also provide other major programmes such as Work Management (WM) to be fully exploited. The NOMS1 and 2 systems previously mentioned will evolve as part of the WM programme and increasingly provide the mechanised link between the 'control' in the NOU and 'execution' in the network field unit (NFU). Further mechanised links with CSS and the front offices will also be more readily forged with the establishment of the NOU Platform.

So the evolutionary path will continue with priority being given to areas of high cost and where service quality improvements are identified. BT will, however, also ensure that each change is fully bedded down and exploited before moving onto the next opportunity.

CONCLUSION

The Network Administration Implementation Programme (NAIP) is an essential enabler to BT becoming the world's best telecommunications operating company (Telco). It is totally consistent with, and an important enabler to, Worldwide Networks, a division of the emerging new BT (Sovereign) organisation. The initiative is fundamentally about meeting customer needs by reducing operating costs, achieving quality objectives and providing the facilities and services the customers require. It is surely the most exciting and radical operations initiative ever implemented in BT. It is also one of the greatest change-management challenges and one of the most crucial to business success. However, by building on its great network successes to date, and through the commitment of its dedicated operations teams, BT can be confident of reaching its goal of being the best Telco in the world.

Biography

Alan Bealby has been very closely involved over the past ten years with modernising the network. Initially, he was responsible for digital exchange planning and provisioning, but, more recently, as General Manager, Network Operations Support (NOS) Department, he has had responsibility for all network support and support systems. He is shortly due to take up a new appointment as Operations Manager, Southern Home Counties. He graduated with honours in Electrical Engineering at Edinburgh University and subsequently obtained an M.Sc. in Administrative Sciences at The City University, London. He is a Chartered Engineer and is President of the IBTE Associate Section.

The Network Administration Implementation Programme—Its Evolution and Management

J. PEACOCK†

The Network Administration Implementation Programme (NAIP) has been set up to manage the implementation of BT's network administration strategy, which is planned to be fully in place by 1995. This article sets out the objectives of NAIP, and describes its management structure and project control methods, which are designed to allow flexibility in securing the full benefits of network administration for the business.

INTRODUCTION

In April 1987, the Network Administration Task Force (NATF) produced a template for administering the network in 1995. The basic building blocks for this template consisted of a three-tier structure namely:

Tier 1 *Central Operations Unit (COU)*

The point at which single tasks are executed for the whole of the network. The best example of a COU task is network traffic management, which is the real-time monitoring and control of traffic flows within the network to maximise the number of successful calls by the efficient use of available plant.

Tier 2 *Network Operations Unit (NOU)*

The major control centres for the network. All network activities will be initiated and controlled from these centres. The most important role for the NOUs will be the remote surveillance and control of all network elements within their catchment.

Tier 3 *Network Field Unit (NFU)*

The management organisation for all field staff. Work which cannot be done remotely is scheduled to the field force from the NOU. The primary role of field managers is to ensure work is of the required quality, staff have the necessary skills/training and are productive, and the correct procedures are being followed.

While the logic of the template was widely accepted, it was clear that the 1995 situation would only be reached by the gradual evolution of today's network support systems, controls, practices and procedures into the 1995 vision.

† Network Operations Support, British Telecom UK

STARTING POINT

The Network Administration Implementation Programme began its work in May 1988, and initial efforts were focused on understanding the scope of the programme and specifically what *administration* meant. In its simplest form, network administration is the way in which people and support systems are deployed in order to manage the network optimally. Taking each term in turn, a more formal definition is as follows:

Network All service-carrying and support plant and systems for both public and private use between customer interface points and through to international frontier station/other administration/other licensed operator interfaces; the sole exception is the local copper access network—the main distribution frame (MDF) line side out to the customer—which is excluded.

Administration The practices, procedures, support systems and structure (both physical and managerial) required optimally to support operations.

Once the scope had been defined, it was also important to have a clear view on the objectives of NAIP.

NAIP Objectives

The primary objective of the NAIP is to provide a network administration that yields significant unit cost reductions, improves quality of service and delivers additional network administration functionality to support the development of the product and service portfolio.

The copper access network is the subject of a separate major change programme which will include administration and is, therefore, outside the scope of NAIP.

DEFINING REQUIREMENTS

Unlike many other programmes, NAIP is operating over a much longer time span, and the

extent to which progress can be made in each of its areas of activity is determined by:

- resource availability,
- realisable benefits, and
- existing support systems.

As individual projects are identified and mature they follow the standard project life cycle. This means that at the current stage of NAIP development there are projects at every stage of their individual life cycles. It is difficult to identify a programme of similar complexity in BT, since NAIP is continuously generating new and unique projects in addition to managing the implementation of earlier projects within the overall NAIP umbrella. The programme cycle is shown in Figure 1 and identifies the tasks that must be managed throughout the life of NAIP. Individually, these six tasks are identified as follows:

Setting the requirements The actions that the programme will address first must be determined and against what criteria.

Steering the programme The necessary senior operations management input must be obtained to influence the direction of the programme.

Managing the programme Having decided what needs to be done, there will be a whole range of projects to be implemented.

Evolving the process The individual processes that are embraced by network administration will gradually change over time as directed by NAIP.

Managing the change-over Attention must be given to managing the change for the people who are affected.

Securing the benefits Projects which commenced with specific benefits identified must realise those benefits for the business when implementation takes place.

For the programme manager, it is important that each of the above tasks is addressed and managed so that the programme cycle operates effectively through to 1995.

EXPERIENCE TO DATE

Project Life Cycle

The individual projects within the NAIP will conform to the elements of the project life cycle

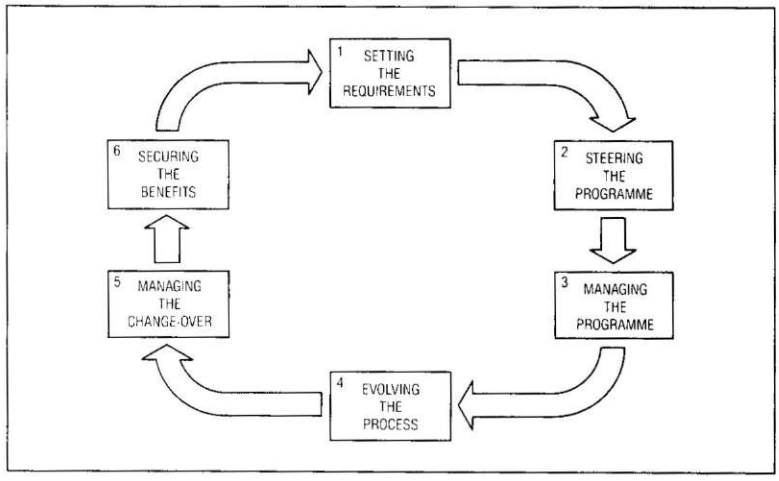


Figure 1
Programme cycle tasks to be managed

shown in Figure 2. In October 1989, a review of NAIP took place which identified scope for improving the way the programme was operating. One requirement was the introduction of more formal project management. This has now been introduced and has forced the individual project managers to renew the feasibility and definition stages of their projects. Out of this exercise has come a better understanding of how the individual projects will deliver for NAIP. There is also a better understanding of how different groups of people are involved at various stages of the development of a project and their specific roles at each stage.

Field/Centre Partnership

At the inception stage of a project, it is important to get as many ideas as possible on the various opportunities available. Since the major impact of NAIP is on field operations, it is essential that field input is obtained throughout the project cycle, but most importantly at this initial stage. The field/centre partnership operated successfully for NATF with over 100 senior operations managers involved in formulating the recommendations. When NAIP began its work, several functional working groups (FWGs) were formed to identify the way forward in their specific areas of activity. These FWGs consisted of field and centre representatives and were targeted with identifying the evolutionary path for their activity. While the FWGs achieved a tremendous amount, a limitation on their operations was identified owing to resource shortages. As part of the NAIP review, it was agreed

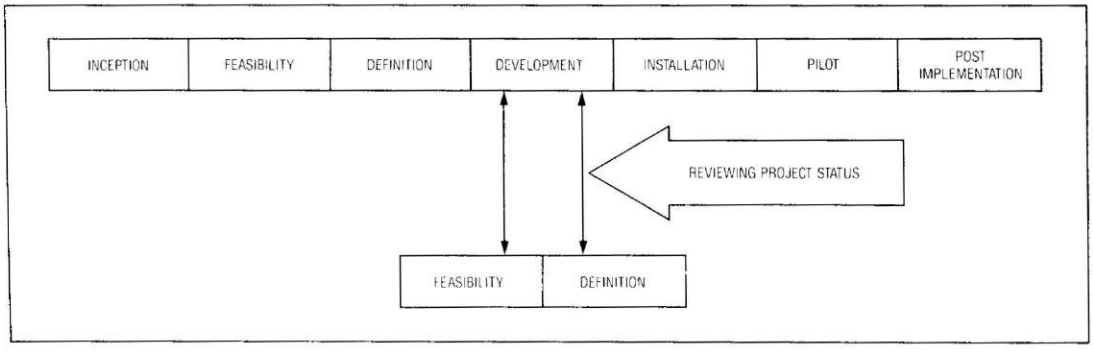


Figure 2
Project life cycle

that resourcing should come in the main from the centre owner and, while the field would be expected to contribute, the main effort would come from head office. This is because they will own the project through to implementation with a continuous involvement of the field. To ensure strong field input, the working group would be chaired by a senior field operations manager. The FWGs have now become client user groups (CUGs) to reflect more accurately their role in identifying on behalf of the client the projects that must be undertaken. Membership will still be drawn from field and centre but now the resourcing is placed upon head office.

The move to process management as defined by the work of the Strategic Systems Plan (SSP) also gives an opportunity to reflect this requirement in the work of the CUGs. They are now very much about process improvement and must structure their future projects around the SSP processes. By identifying the make up and operating costs around processes, it will be possible to structure projects that streamline the processes and reduce operating costs. The use of formal work study will be an added tool in ensuring that the true situation is identified and improved.

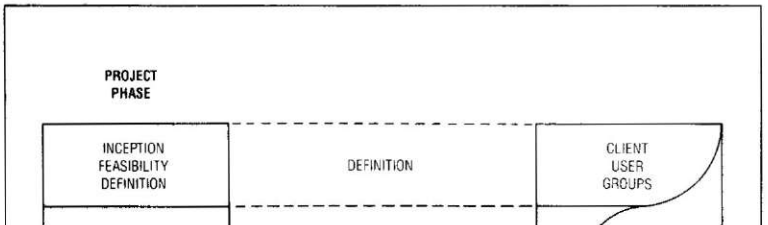


Figure 3—Group involvement in project life cycle

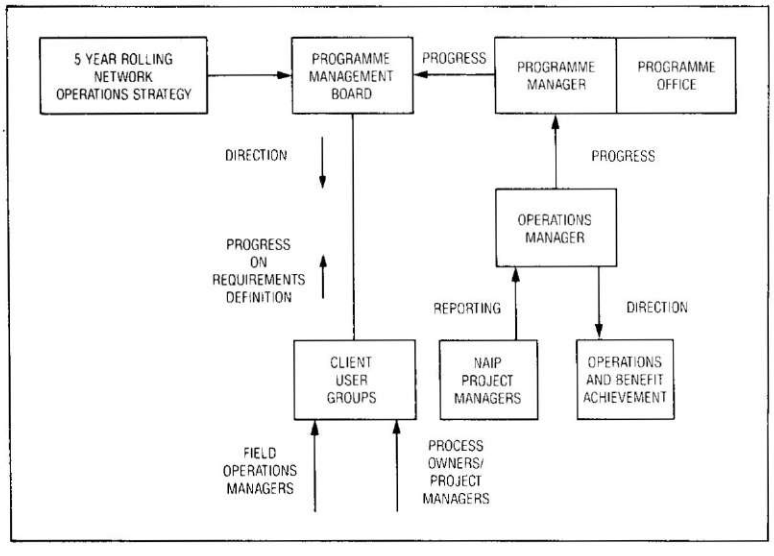


Figure 4—NAIP management structure

Process Improvement

When a project has been identified through the CUGs, the process project manager (PPM) obtains a client requirement definition (CRD) which broadly states what must be delivered. A feasibility study is then completed by the PPM which identifies the different options available to meet the client's requirement and recommends the option that best meets the client's time, cost and quality requirements. Field staff are also involved at this stage in that a field expert, in this process area, for each catchment area has to be satisfied that the recommended option will achieve its stated objectives. When the field and CUG are satisfied with the feasibility recommendation, the project requirement definition (PRD) is produced. This spells out in detail the description of the project and its benefits. Again the CUG and the local catchment owner must be satisfied that the detail given will enable the project to achieve its objectives.

If acceptable, the PRD becomes the monitoring document through which the CUG maintains visibility of progress. A significant step forward was achieved by clearly defining the role of the PPM who must co-ordinate all the necessary deliverables to ensure the project meets the client's requirements.

Implementation

It is important that each project is demonstrated successfully in the live environment before it is rolled out nationally. To this end, the pilot local owner must be satisfied that the development and installation of the project deliverables will meet the project objectives and that this is demonstrated in the live environment. When the project has successfully demonstrated that it has met its acceptance criteria, it can be rolled out nationally. Each local owner will also have to be satisfied that the project has met its local acceptance criteria before roll-out can be deemed to be successful.

The extent of involvement of the identified groups at the various stages of the project cycle is shown in Figure 3.

NAIP MANAGEMENT STRUCTURE

A complex programme like NAIP has to be carefully managed through all the stages of its life cycle; Figure 4 illustrates the management structure that has evolved over the last two years.

Client User Groups

The CUG, consisting of field and head office representatives and chaired by a senior field operations manager, defines the way forward for its particular process improvement projects.

There will be five CUGs with clear process responsibilities, and two further CUGs looking at organisation and coherence and system architecture. On three or four occasions per year, all CUG chairmen will meet at an operational conference, or workshop, to pull together an overall view of programme progress.

Programme Management Board (PMB)

The Programme Management Board (PMB) provides the top level control for NAIP ensuring that business requirements are correctly interpreted through the work of the various groups within the programme.

The PMB members are operations directors and centre directors who together will give policy guidance and steerage in the following areas:

Define business needs
Provide direction on clients' requirements
Review progress of each project phase
Decide priorities
Sign off benefits
Monitor/review programme plan and delivery
Perform audit function

Programme Manager

The appointment of a programme manager identifies a single individual accountable for the management of the programme. His/her task is to meet the client's requirements on cost, time and quality for the programme.

Programme Office

The programme office assists the programme manager in the centre by monitoring and reporting progress of the programme and its individual projects through to implementation. This will include support and advice for the various individuals and groups, that make up the NAIP management structure, in achieving their milestones for the programme. The programme manager will work closely with the field directors programme office.

Process Project Managers

The ongoing responsibility for progressing process improvements rests with head office, and it is here that the PPMs are situated. Receiving their projects from the CUGs, they are the deliverers to the programme and report progress on achieving their milestones to the programme manager.

Project Implementation Managers

Each designated NOU catchment has a project implementation manager who is responsible for preparing the infrastructure to receive the people and systems as they are delivered. As field managers they also report to the senior operations manager within the NOU catchment.

Operations Manager

The savings and benefits, in concert with the process project managers and project implementation managers, must be realised by the operations manager, who is therefore involved in early sight of the deliverables. This gives the opportunity to sign off the savings and benefits and ensure they are delivered as the NOU develops.

NOU SITES AND CATCHMENTS

When NAIP addressed likely catchments and sites, a set of criteria was produced to assist selection. Those early sites and catchments were based on BT's traditional Regional structure and resulted in 12 NOUs being identified (three of which were for London). With the advent of Project Sovereign and the formation of Worldwide Networks, the opportunity has been taken to ensure conformance of NAIP. It should be emphasised that the NAIP is an enabler for Project Sovereign, and network administration is still an essential ingredient to successful future operations. The NOU catchments under Project Sovereign are shown in Figure 5 and sites and proposed openings are shown in Table 1.

Figure 5 NOU catchment areas and sites

TABLE 1
NOU Site Opening Schedule

Catchment	Site	Proposed Opening
Scotland	Edinburgh	19 November 1990
North West	Manchester	Open
North East	Leeds	February 1991
Midlands	Walsall	Open
Northern Home Counties	Cambridge	March 1991
Wales and South West	Bristol	April 1991
Southern Home Counties	Worthing	May 1991
London	BT Tower	July 1991
Northern Ireland	Belfast	January 1991

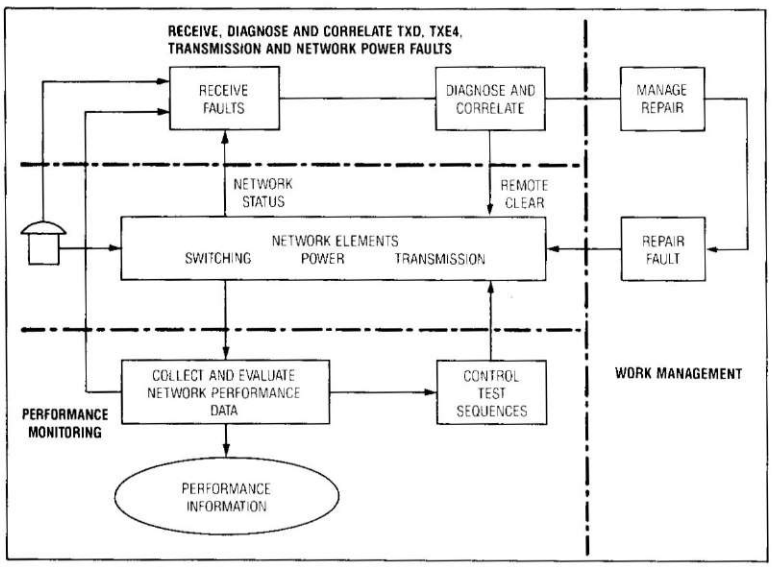


Figure 6
Work Management Programme

An NOU will be considered to be open when the first task that conforms to the agreed practice is carried out from the site.

FINANCIAL AUTHORITY

Since NAIP is a programme that is continuously evolving, it is necessary to upgrade the financial requirements every year. In November 1989, the British Telecom Management Board (BTMB) authorised expenditure of £25·5M to open the NOUs and provide the initial deliverables. The first implementation will form the Platform on which future functionality will be added. To ensure financial concurrence, each project within the NAIP must seek individual financial authority before any money is spent.

The BTMB also requires regular progress reports on authorised projects so that actual cost and benefit can be measured against the plan.

All new tranches of NAIP projects will be managed through to implementation in this manner. In this way, visibility is maintained for senior management of the costs and benefits of the programme.

INTERFACES WITH OTHER PROGRAMMES

There are many programmes operating within BT that impinge on NAIP and must therefore be correctly interpreted in terms of their interfaces. There must be awareness of customer-facing programmes to ensure that the NAIP does not become isolated from customer needs. The NAIP also has links with other programmes to deliver systems and functionality. A typical example of this is the Work Management Programme (WMP). Figure 6 shows that for the Platform the WMP will deliver the means of allocating work to the field. This enables the NOU to allocate tasks successfully after correctly identifying, through its own systems, what needs to be done. Only by working closely with these other important programmes will NAIP keep in step and ensure its requirements are adequately identified.

CONCLUSION

Many important lessons have been learnt since May 1988 on how best to manage a programme such as NAIP. NAIP will not stand still and 1995 is sufficiently distant to incorporate many further changes as requirements change to match customer expectations. The old distinctions between field and head office have created unnecessary barriers in the past, but these are gradually disappearing through the successful operation of CUGs. The field must have a major influence over the course of NAIP because its major impact is in this area.

The focus on process improvement and the greater use of feasibility and work study will make NAIP more responsive to operational needs. A strong and effective Programme Management Board with clearly defined responsibilities will give NAIP the necessary credibility within BT. In the environment created by Worldwide Networks, NAIP will prosper since it offers a real opportunity to establish national solutions to national problems. The successful management of the evolution of NAIP will ensure that it remains the essential enabler to a network administration that is second to none.

Biography

Jeff Peacock has been the NAIP Manager since October 1989 after being involved in preparing the original strategic document. He is a Chartered Engineer and a Member of the Institution of Electrical Engineers.

Project Management and its Application to the Network Administration Implementation Programme

D. R. TRENT†

Project management has been formally adopted by British Telecom for application to its projects and programmes. This article outlines the principles of project management and discusses its application to the Network Administration Implementation Programme.

INTRODUCTION

The purpose of project management is to ensure that projects deliver their objectives on time, to agreed costs and to agreed quality levels. It has become a well-established discipline in British Telecom for both engineering development and implementation projects and programmes. Its application has, for example, enabled BT to secure its world leadership in modernising the network in a major programme which last year alone resulted in 4·6 million digital exchanges lines being brought into service.

The Network Administration Implementation Programme (NAIP) is, however, not just about developing and installing new equipment. It is also very much about other matters such as practices, procedures and organisation of staff. Changes to these have in the main evolved with time, but in the competitive environment they demand rigorous business-wide management. Moreover, NAIP is a programme which comprises a complex matrix of interrelated projects covering a wide scope and itself has interfaces with other programmes. It therefore presents a challenging programme management task.

Companion articles in this issue of the *Journal* illustrate the practical application of project management within NAIP; this article discusses the principles of project management and outlines the evolution in its application to NAIP and some of the lessons learned.

PRINCIPLES OF PROJECT MANAGEMENT

Project management is a discipline designed to enable the systematic planning, control and execution of a project. The activities within a project are normally completed in a specific sequence—the *project life cycle* (Table 1)—and to prescribed objectives of time, cost and quality. The clarity and discipline that the project management methodology provides contributes significantly to reducing the cost of failure. It is, therefore, entirely consistent with *total quality management* which has also been adopted by the company.

TABLE 1
Project Life Cycle

Inception Feasibility Definition	Definition Stage
Development Installation Pilot	Development Stage
Roll-out Post-implementation	Roll-out Stage

A programme comprises a number of projects grouped together to contribute to the achievement of specific objectives and, once fully launched, cannot usually be represented by a life cycle since the constituent projects will be at different stages in their own life cycles. However, the same, but extended, principles and disciplines apply.

Prerequisites

Project management is dependent on the following in order for the key objectives of time, cost and quality to be met:

Programme Management Organisation
This must be well defined and understood. In a programme of the scope of NAIP, many organisational units contribute to specific elements. A matrix organisation is required in these circumstances to manage across functional and geographic boundaries.

Roles and Responsibilities In a matrix environment, it is particularly important that the people involved clearly understand their individual roles and responsibilities as well as those of others. In order to ensure this, it is essential that effective communications mechanisms are in place and that the key position of project man-

† Network Operations Support, British Telecom UK

ager, who is accountable for the delivery of the objectives, is filled at an early stage.

Procedures and Methodologies These must be well defined and understood by all those involved. They must include a common language and terminology to avoid confusion.

All these elements must comprehend the differing requirements of each stage of the project life cycle.

The Project Life Cycle

A project usually consists of a number of work packages linked together in an overall plan. They are carried out in a specific sequence—the life cycle of a project illustrated in Table 1. The key point of the life cycle is the need to review the project with the client, in terms of time, cost and quality, at the end of each phase and determine whether progression to the next phase is justified. This opportunity to repeat a phase or, indeed, stop projects which are, say, overrunning on cost and time is an important one. The reader can no doubt identify well-known projects which, if a formal review had been carried out at an early stage, would have resulted in their cessation and diversion of the planned investment to more rewarding work.

The terms, in Table 1, are those used in BTUK's own project management standards. Other standards use different terms but the phases can all essentially be grouped into three key stages:

Definition Stage

This stage begins at inception with an initial project proposal to meet a business need. This is further developed into a client requirements definition (CRD). The client, who is accountable for the overall investment in the project, is responsible for defining his/her requirements of the project in conjunction with the users, who must operate and maintain the output of a project, ensuring it addresses essential business needs. The CRD is the vehicle to capture the requirements which at this stage are essentially targets to achieve.

After the production of the CRD, a study to determine the feasibility of achieving the project objectives is conducted. This phase should conclude with the recommendation of a preferred solution supported by an analysis of outline costs, benefits and time-scales of the available options.

The stage is completed with the full definition of the project and includes the creation of:

- a project requirements definition (PRD) which states what is to be produced and what the project must achieve, and
- a project plan stating how it is to be achieved, including a breakdown of all the work packages.

Normal BT financial control means that, before moving on from this stage, approval of the project plan and financial authority must be secured. This must be supported by sign-off by the user representatives that the project is deliverable.

Development Stage

This stage includes much of the work to put the project plan into effect. The development phase can include design, hardware and software development, production of documentation, job design, procurement, etc.

The project deliverable is then installed and tested in preparation for the pilot phase. The purpose of this phase is to test the deliverable, against the defined success criteria, in a working environment such that modifications can be made to correct any operational difficulties encountered.

Roll-Out Stage

After successful piloting, the project is rolled-out to the remaining sites or installations. In practice, roll-out is usually treated as a programme of individual projects.

After roll-out, a post-implementation review is conducted to ensure that the project has delivered its time, cost and quality requirements. Valuable lessons may also be learned at this stage so that future projects are made easier or more successful.

Change Control

Once the definition stage is completed, any changes to the project must go through formal change control. Many projects fail as a result of too many changes being made during the later phases, when both the cost of change has escalated and the logistics of change have become difficult.

The main objective of change control is, therefore, to reduce the number of changes to those absolutely essential for success. The process is also designed to ensure that all affected people in all associated work areas are consulted and the impact assessed before the change is agreed. All changes which affect the project deliverable should be approved by the client.

APPLICATION TO THE NAIP

Organising NAIP

The NAIP management structure is outlined in another article[1] in this issue. It has been designed in recognition of the fact that NAIP comprises a large number of projects at different stages in their life cycles requiring co-ordination and management as an homogeneous whole. To ensure this, there is effectively a reporting structure for each of the three main project stages.

The prime accountabilities of the various players in a project change during the project life cycle, and are given in Table 2.

This representation is somewhat simplified and does not reflect the involvement of many people at each stage. Roles and responsibilities have evolved in the short life of NAIP as some of the grey areas between involvement and accountability have been clarified. Some of the key issues will be discussed later. However, there are two main themes which have been consistently applied:

- The commitment to a strong field input to the definition stage. It was for this reason that, when NAIP was established in May 1988, CUGs were created (though initially called *functional working groups* (FWGs)). The field members of these groups represent both users and client and, as such, sign off each project before it passes through each phase of its life cycle.
- The responsibility of the project manager for delivery of a project from inception to post-implementation assessment. The implications of the qualifier 'process' for some project managers, indicated in Table 2, are outlined in the next two sections.

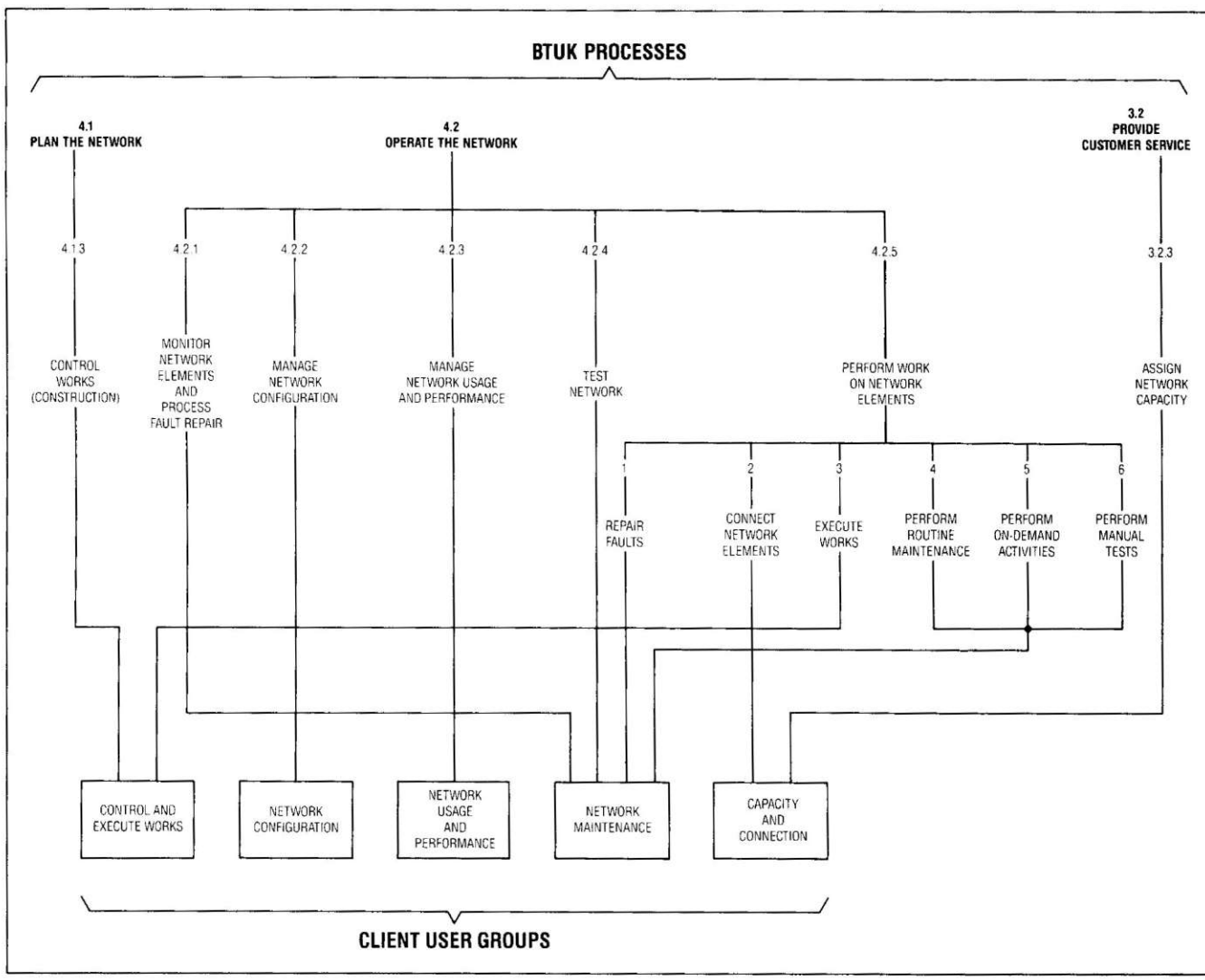
TABLE 2
Prime Accountabilities

Project Stage	Prime Accountabilities
Definition	Client user groups (CUGs) (Process) project managers
Development	(Process) project managers Work package managers Pilot sites
Roll-out	(Process) project managers Work package managers Operations managers (field) Local project managers (field)

Alignment with the BTUK Strategic Systems Plan (SSP)

Any large programme and its supporting organisation needs to be broken down into manageable

Figure 1
SSP/CUG mapping



units. A logical functional breakdown was therefore derived for the CUGs (hence the original term *functional working groups*), which defined the areas of network administration each group would address.

However, very early on, it was decided to map the programme onto the business processes model being developed through the BTUK Strategic Systems Plan (SSP)[2]. This would ensure that the work of NAIP would be on the migration path to BTUK's future business operations model and, in specifying computer support systems, would contribute to the long-term information systems architecture.

The functional alignment of the CUGs has changed slightly as BTUK's future operations model has developed. Figure 1 illustrates the process scope of NAIP within the BTUK model and how the client user groups have been mapped onto it.

The organisation at Headquarters is also evolving to conform to the process model, and process managers are being nominated who will be responsible for the effectiveness of operation of their processes in the field and for managing improvements in process operation. They are key members of the CUGs.

This focus and alignment on processes within an objectively structured business model is enabling a very disciplined approach to change. In particular, it is encouraging the development of an understanding of the component business processes and more fundamental thinking about the process changes required to deliver benefits for the company. Once these have been identified, full definition of the change and a work breakdown specify enablers to their achievement. Thus simple solutions to problems are now being identified which previously may have been addressed by a more complex technological approach.

Work Breakdown

Once a process change has been identified by a CUG, a process project manager (PPM) should be appointed. The project manager, who should have both the project management skills and the technical expertise in the area concerned, will, in most cases, be an in-line reportee to the process manager. He will, after sign-off of the CRD, be responsible for fully defining the project and producing a complete work breakdown structure (WBS) detailing the individual work packages.

For most process projects, the initial stage of work breakdown is as shown in Figure 2, from which it can be seen that, in NAIP, there are essentially three types of work packages: procedures, support systems, and people.

The process project manager will normally be the manager of the procedure work packages. The PPM will also be responsible for specifying the functional requirements of any support systems needed. In most cases, a number of process projects place requirements on one support system. It is the role of the Network Control Architecture Board, referred to in another article[3], to map requirements onto support systems.

In the case of work packages addressing people issues, these are implemented by the personnel function who give guidance and support to the PPMs.

Roles and Responsibilities

In any large matrix organisation, clarity of roles and responsibilities is essential for programme objectives to be delivered. Although this was recognised right at the start of NAIP, and roles and responsibilities were documented, a full understanding by all project participants has yet to be achieved. This is largely because, as the

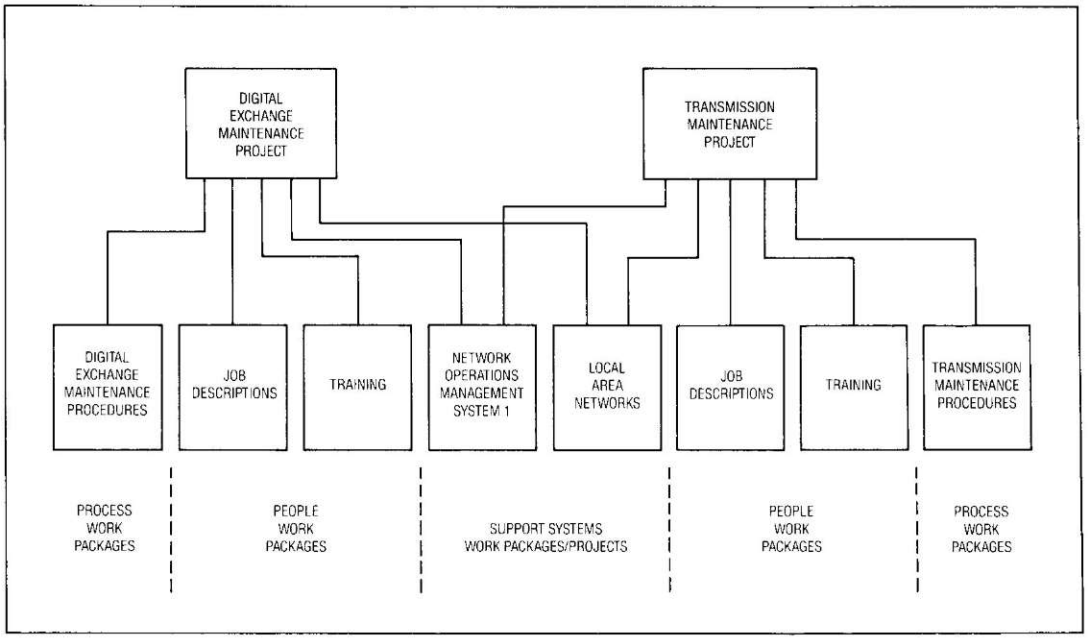


Figure 2 NAIP work breakdown

programme and the concept of process management have evolved, so have roles and responsibilities. It has also underlined the key importance of effective communications in such a large programme.

However, at odds with this need for clarity of role is the fact that, in a competitive environment, flexibility is required to respond to new challenges. NAIP is dependent on so much cross-functional co-operation and working that roles can, and sometimes must, become blurred to achieve a common goal. A balance has therefore to be achieved between clear definition of accountability and exploiting the benefits of flexible, creative alliances.

Definition of the Programme

It is apparent that perhaps the most crucial part of a project's life cycle is that leading to conclusion of the definition stage. This clearly also applies to NAIP as a whole. This was recognised at the inception of NAIP and was the reason for the establishment of the CUGs and commitment to the strong field input.

Realisation of the ambition has proven to be even more challenging than originally realised. The two main factors were referred to in the introduction:

- the sheer scale of NAIP, and
- the significant cultural impact of the application of rigorous project management to changes that have historically simply evolved.

Moreover, NAIP is being managed in an environment where more stringent financial controls, in particular, the need to demonstrate achievement, are being applied.

The first focus of the CUGs was to establish their vision, to determine the current position, and trace, in outline, the route map to the vision with key milestones identified. The proposals had to be justified by an outline business case.

This was a most valuable first phase which put into perspective the scale of what NAIP was trying to achieve. Through this it was recognised that the projects would need to be delivered in manageable tranches; that a higher than anticipated resource commitment was required, particularly in the NAIP Management Office; and that the initial time-scales were too ambitious. It also highlighted a tendency to focus too heavily on the development of support systems. Here, as already noted, the discipline of process management provided the key.

The next focus of the CUGs was on the definition of the first tranche. As can be seen from other articles, this tranche focusses on network maintenance operations and is known as the *Platform*.

A key plank of the Platform is the establishment of national standard practices selected from the most appropriate already in operation. This approach of establishing a foundation, based on good work that had already been done, offered the opportunity to reduce the effort required in the development stage. However, it did not take the pressure off the need both adequately to define the individual projects in PRDs, including standard practice selection criteria, and to secure sign-off by the field users. Moreover, there have been complex linkages between the projects to be defined and managed.

Definition of the Platform projects has proved to be one of the most difficult challenges faced in NAIP so far. However, the hard work of many throughout the company is paying off. The Platform will be delivered on time, and cost and quality objectives will be met, indeed exceeded.

CONCLUSIONS

The formal adoption by BT of a standard project management methodology has set the way forward to better control of all projects and the successful achievement of business objectives. NAIP is breaking much new ground in the application of both this and process management. Some hard lessons have been learned. However, the benefits are already apparent and the work has laid the foundation for successful process and project management in the future.

References

1 PEACOCK, J. The Network Administration Implementation Programme—Its Evolution and Management. *Br. Telecommun. Eng.*, Oct. 1990 (this issue).

2 BROWN, D. W., BELL, R. C., and MOUNTFORD, J. A. Strategic Planning of Business Operations and Information Systems. *ibid.*, Apr. 1990, **9**, p. 16.

3 SAVAGE, S. P. The Selection of Support Systems for Network Administration. *ibid.*, Oct. 1990 (this issue).

Biography

David Trent is the manager responsible for the implementation of the NAIP Platform. He joined the then British Post Office in 1968 as a Post Office Student and gained a B.Sc. in Electrical and Electronic Engineering from Leeds University in 1972. His early work included operator systems and TXE4. He was a member of one of the System Y evaluation teams and subsequently was responsible for establishing the support organisation and arrangements for the chosen system—AXE10. After this, he headed the Digital Exchange Operations and Maintenance unit before moving on to the NAIP.

Management of Change—Theory and Practice in the Network Administration Implementation Programme

. LOCKHART†, and J. YOUNG*

When introducing new technology, attention should focus not only on technical concerns, but also on the human and organisational issues which inevitably result. The ultimate success of any change programme will critically depend on how well these issues are managed. This article outlines the theory behind management of change, in particular why companies need to change; why the change needs to be managed; how this process should be undertaken; and how potential barriers to change can be overcome. Experience of how the Network Administration Implementation Programme has attempted to manage the change, and address the people and organisational issues is outlined.

INTRODUCTION

Over the past years, companies have increasingly turned to new technology, aiming to improve effectivess and efficiency. Past experience has shown, however, that, while many companies have spent considerable sums of money on new technology, the expected benefits frequently have not been fully realised.

When introducing new technology, technical concerns are only one of the factors which have to be examined. Of equal importance are the organisation and human consequences of introducing the technology, and the management of these issues is critical to ultimate success.

The Network Administration Implementation Programme (NAIP) is just one example of where British Telecom is using and exploiting new technology to reduce costs and improve the quality of service to the customer. While considerable attention is being devoted to the development of the technology in NAIP, increasingly managers and staff have recognised that the human side also needs to be managed, if the programme is going to deliver to the full its expected benefits.

This article broadly outlines why change needs to be managed not just implemented, details some of the factors which have to be addressed in this process, and describes how change is being managed within NAIP.

WHY CHANGE?

'It follows that an acceleration in the rate of change will result in an increasing need for reorganisation. Reorganisation is usually feared, because it means disturbance of the status quo, a threat to people's vested interests in their jobs, and an upset to established ways of doing things. For these reasons, needed reorganisation is often deferred, with a resulting loss in effectiveness and an increase in cost.' (Bower and Walton)

Organisations which do not change and develop in response to, and in anticipation of, changes in the environment, are doomed to failure. Organisations do not exist in a vacuum. Rather, they are constantly interacting with the environment, and consequently need to be prepared to change to meet the requirements arising from external factors.

Figure 1 highlights some of the external factors which will have an impact on an organisation. In order to survive, organisations will, as a minimum, have to react to changes in these factors, sooner if not later. However, organisations likely to be most successful in the future are those which adopt a proactive approach when devising strategies to address these factors: these organisations will have the most favourable outcomes, not only for the business as a whole, but also for the individuals within it.

The need for organisations to develop in the light of changing external factors is highlighted in the example of the Ford Motor Company. When Ford first started manufacturing a new make of car (the Model T Ford), customers were advised that they could have any colour—provided it was black! Over the years, Ford, and the service the company offers, have had to change in response to changes in technology, changes in the demands of the customer, and increased competition from other motor companies.

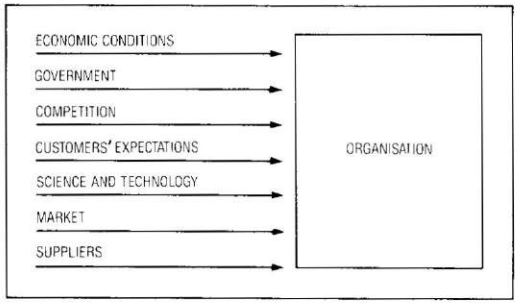


Figure 1—External impacts on organisations

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Likewise, British Telecom is having to change in response to external demands. Looking back over the history of telecommunications in Britain, particularly over the last 10 years, it is evident how much the industry has developed and grown, with liberalisation, privatisation, District reorganisation and digitalisation, to name but a few. The next ten years will necessitate more fundamental changes by BT as it enters into an even more competitive environment—customers with increasingly sophisticated requirements and higher expectations, having the choice of a much wider range of suppliers.

Given the continuing need to upgrade the service to customers, a number of company-wide change initiatives have been launched within BT in the last five years. These changes include the introduction of Customer Service Systems (CSS), the Work Management Programme, NAIP, the introduction and development of total quality management and, most recent of all, the reorganisation/rationalisation of the company through Project Sovereign. These changes are not taking place in isolation from one another—rather the aim is for them to be mutually supportive in achieving business objectives.

WHY MANAGE CHANGE?

Successful or goal directed change does not simply happen. Rather, change is something that needs to be planned and managed with considerable care, in order to ensure that the outcomes achieved are those which are beneficial for the business and are willingly adopted by those directly or indirectly affected by the change.

The need to manage change stems from the complexity of organisations, which can be seen as sets of interdependent social and technical systems. The framework given in Figure 2 is one way of representing these interdependent components.

Changing one element of the organisation inevitably results in the need to change aspects of most, if not all, the other elements. Thus, in bringing in a major technological change, not only is there a need to understand which existing systems the new technology will replace or interface with, but also what changes are required in all the other elements.

Change can impact on areas such as the tasks to be carried out by staff within the organisation, and the skills required to perform these tasks; the human resource issues of recruitment, training, relocation etc; the changes in departmental and organisational structure; the future direction of the organisation; leadership style; and last, but by no means least, the pervading culture of the organisation.

If we consider NAIP, the scope of the changes is great and will almost inevitably impact upon the elements highlighted above.

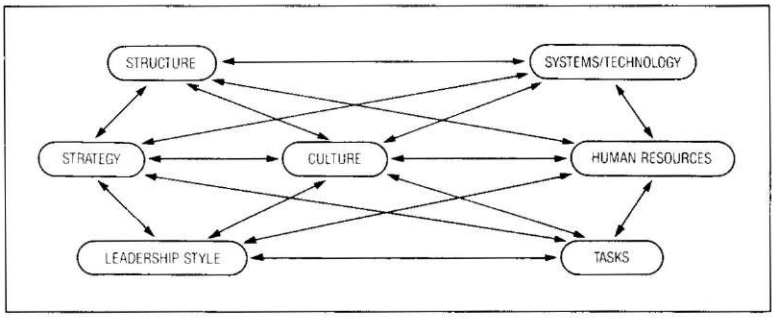


Figure 2 Organisational framework

SCOPE OF NAIP CHANGE

Traditionally, maintenance staff have been located close to the equipment to be maintained, in order to provide a rapid response to faults and customer-related requirements. The availability of electronic, digital and software-controlled equipment has reduced faults, made some faults less time critical and enabled some tasks to be done remotely. In addition, electronics facilitates an overview of switch and transmission performance, which is more closely aligned to customer use of the network. To realise these benefits, it is necessary to centralise the surveillance and control of the network at convenient nodes (the network operations units (NOUs)), which direct the necessary site visits by a mostly travelling workforce (the network field units (NFUs)). This arrangement facilitates event management, for example, relating a transmission failure to customer fault reports, and some integration of works and maintenance activities.

These are significant changes, but not the end of the story. In the not-to-distant future, software developments promise even more remote repair facilities—the realisation of 'hands off' maintenance. In addition, the developing role of network engineers will be to design and operate the network, such that customer-facing staff can directly test, set and reconfigure the network to meet customers' needs. While in the longer term, customers could be offered the option of some 'do-it-yourself' reconfiguration of their own services.

Together with Project Sovereign, the changes will also mean a much simpler management structure with fewer levels. In turn, this will mean better communication and implementation of changes such as new services and quality improvement. Currently, there are many good ideas that have been developed in one part of the country, which cannot be used elsewhere because of different systems and procedures. With the greater standardisation through NAIP, any improvements will be transferable throughout the network. In turn, this will mean changes at Headquarters where it will be possible to draw representatives from each NOU onto development teams. Or, an NOU might develop and pilot its own initiative with assistance from HQ and other NOUs.

BT, like many other companies, is beginning to recognise that change needs to be managed. It is not sufficient to focus on the development of a particular system, and consider its impact on other elements of the organisation at a later date. The impact of any proposed change on the organisation as a whole needs to be considered carefully right from the onset.

HOW TO MANAGE CHANGE

The basis of any kind of change which is more likely to achieve positive worthwhile results is:

(*a*) being clear about where you are starting from,

(*b*) having a clear picture of where you want to get to, and

(*c*) identifying the logical steps required to make that move.

Figure 3 provides a model for managing this process.

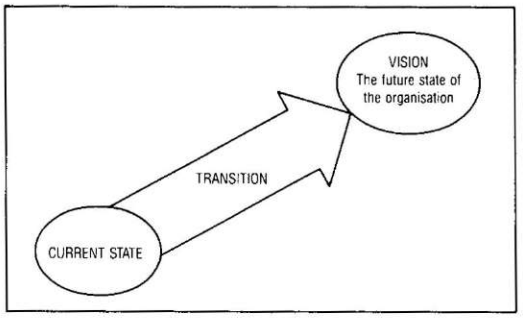


Figure 3 Model for organisational change

Current State

When thinking about changing any aspect of the way work is organised or carried out, an important prerequisite is a picture of the current situation. It is only when a clear picture emerges of how work is currently organised in terms of work procedures, structure, work flows etc. that problems and opportunities can be identified and proposed changes envisaged.

In order to gain commitment from staff and managers to the proposed changes, it is also worthwhile ascertaining their readiness (attitudes to change) and capability (skills to operate the new systems and perform effectively in redesigned jobs).

Future Situation

Change will be most effective if it is driven against a vision of how the organisation should be operating in the short (1 year), medium (2–3 years) and long term (3–5 years). This vision should be explicit and shared by all those affected by the change. Furthermore, it should consider all elements of the organisation, and how they are likely to be impacted by the changes. Such vision sharing, once established, cannot be assumed to remain firm and unshaken during the change process. It will be necessary to check constantly that those involved still have a clear picture of what the future situation will look like, and still retain commitment to that end.

Transition Management

Only when there is a picture of how work is organised now, and what changes would help deliver the future vision, can an action plan of phased and co-ordinated innovation be developed to manage the transition.

It is worth stressing that, while there are three distinct phases to managing change, arriving at the future picture does not mean that the process is complete. Change and improvement are continuous, and it is only by continually picturing how things can be better that organisations can remain effective and efficient.

'When a dream becomes reality, it's time to change the dream' (G. Moreas). The route to that future picture, however, is not always straightforward, and there is a need to review progress continually and change course as appropriate to that journey.

The change model outlined in this Section is one simplified way of looking at managing change. What is key is the need to consider the impact on the people within the organisation right from the very beginning. In analysing the current state, developing the future state and managing the transition, all the elements of the organisation, as outlined earlier, need to be considered and clarified.

Likewise, in project management—in essence a change management model incorporating a number of organised improvements in a current situation—there needs to be focus on people. Unfortunately, all too often, major change processes that involve technology leave the organisational and people issues relatively well behind. (See Figure 4.) However, if the 'people' aspects are given insufficient attention right at the beginning of a proposed change (at inception stage), sooner or later the resulting shortfall in progress will demand remedial action.

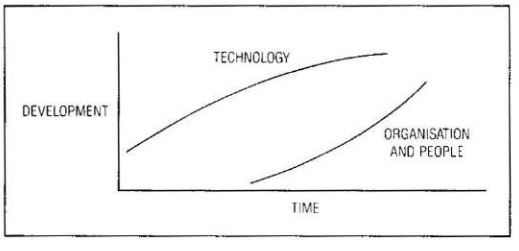


Figure 4—Development of technology and organisation

If change is to be most effective, these two advancement curves need to be brought together as early as possible so that they develop consistently from inception through to implementation.

BARRIERS TO CHANGE AND HOW TO OVERCOME THEM

When introducing any changes, it is almost inevitable that there is going to be some resist-

ance because there will always be a degree of uncertainty about what will actually happen, particularly at the beginning. Naturally, people who are affected by change are likely to experience some emotional turmoil. Their reactions to change can vary considerably, from positive acceptance to open hostility and resistance. Every individual's likely responses need to be considered and anticipated, their concerns respected and dealt with sympathetically, and appropriate support and advice given prior to any decision that they ultimately make. In order to manage change successfully, it is essential to have some understanding of how and why people react to change. Some of the more common reasons for negative response to change are highlighted below:

(*a*) *Loss of control* The more changes are perceived as being imposed on individuals, the greater the likelihood of resistance to that change and the greater the degree of resistance. Individuals in this situation are likely to feel out of control, powerless and stressed, and consequently behave in a variety of defensive, territorial and seemingly petty ways.

Involving people in any project, by providing them with a measure of choice and giving them an opportunity to contribute to the planning and implementation of change, will greatly increase the chances of their feeling committed to that change. In particular, they may be involved in the refinement of proposed improvements to ensure the best fit with preferred ways of working, or in the design of changes to their working environment, such as office layout. They may also be asked to participate in data collection about the potential impact of proposed changes.

(*b*) *Increased uncertainty* One consequence of change can be discomfort and confusion if there is lack of clarity about the future and about individuals' roles within that future picture. This lack of certainty about the future can lead to a reluctance to relinquish the past and move towards the future.

In order to decrease this uncertainty, a picture of what the changes are hoping to achieve, and the role individuals will play in that future picture, should be shared at every stage of the project. Communicating and sharing information with all those involved contributes greatly towards individuals feeling committed to change. Communication needs to be a two-way process to ensure people understand how the technology will ultimately reduce, rather than add to their current problems, and to provide them with the opportunity to air any of their concerns. It may also have value in raising people's awareness of their own situation to the level that they can match the proposed solution to their own perceived 'problems'.

(*c*) *Taken by surprise* Individuals are more likely to resist change if it is sprung upon them with no warning or opportunity to influence or adapt to that change. It is, therefore, essential to provide advance warning. The timing of this communication is crucial and sufficient notice needs to be given to enable individuals to come to terms and adjust to the proposed changes.

(*d*) *Concerns over competence* Fear of not being able to operate effectively in the new environment, and the concern that face could be lost with colleagues and superiors, are two of the most common barriers to change. Changes may result in individuals working in new conditions with new systems and procedures, and possibly with new colleagues and managers. In order to ensure these changes are wholly accepted, individuals need to feel confident that they have the skills and knowledge necessary to work effectively in the new environment.

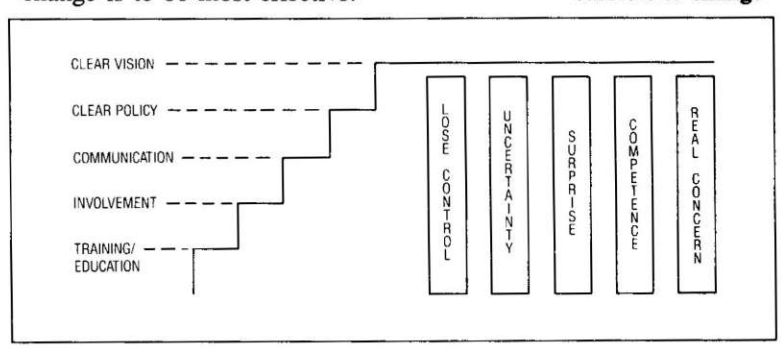
In order to overcome this barrier, it is essential to provide the necessary training and education to enable all members of staff to work to the required performance standards. They may need to be given the chance to practise without fear of being judged, or feeling stupid, and managers are likely to be required to provide positive reinforcement and encouragement on a regular basis and more frequently than usual.

(*e*) *Sometimes the concern is real* In some cases, individuals' fears may be realised in terms of relocation, or redundancy. In such cases, disagreement with the proposals is likely to be deep and persistent and needs even more careful and sympathetic handling.

A clear company-wide policy is crucial for dealing with these eventualities, and the reality of the situation must be recognised. It is important that there is no pretence or false promises made, and information should be provided to those concerned as soon as it is available. Support mechanisms, such as counsellors, need to be put in place to provide guidance and support to those affected. In these circumstances, union involvement is critical if smooth implementation is to be ensured.

When introducing change, it is difficult to predict accurately how people will react. However, it is only by being aware of the potential areas of resistance that strategies can be put into place to help the organisation, and individuals within the organisation, to overcome these barriers (see Figure 5). What is key is that resistance should not be ignored. Rather, it should be surfaced, and the concerns of the people within the organisations dealt with respectfully, if the change is to be most effective.

Figure 5 Overcoming barriers to change



MANAGING CHANGE IN PRACTICE

Those within NAIP have recognised that, while the programme impacts significantly on network controls, support systems and network technology, its effects on traditional practices and procedures for managers, technicians and non-engineering grades are equally significant, if not more so. Managers involved in different aspects of the programme have acknowledged the need to address the 'people' issues and to develop a new culture alongside the systems, if the network is to be effectively managed in the future.

While it is important to recognise the organisational and people implications of NAIP, it is the addressing of these issues which is paramount. It is not what is said, but what is actually done that counts in the long term. The remainder of the article conveys some aspects of the work which has been undertaken specifically to address management of change.

THE IMPACT OF NAIP CHANGES

The changes arising from NAIP are many and varied, ranging from setting up new accommodation to designing new computer systems. These are familiar activities, although management discipline and control has been much improved by the enhanced status of project management. However, as outlined, it is the 'people' issues which have required careful and thoughtful consideration with such a major change being planned. Experience has shown that managers associated with the changes require considerable support to enable them to address the people issues in order to achieve the stated objectives of NAIP.

Not unexpectedly, it is the NOU which has made the headlines, because it is the first and most significant impact of NAIP. However, it is important to appreciate that the number of staff employed in the NOUs is only a small proportion of the total network staff. The vast majority of network operations staff will still be undertaking work which is not vastly different from the present tasks, although sometimes at different locations. The normal pattern of continuous change will continue for most planning and works staff.

The crucial questions which are always asked are: 'Will there be a job for me?', and 'How will it affect me?'. It is not easy to answer these questions convincingly. The problem is that the questions are asked at the conceptual stage of the project, but job allocation to individual employees must await the completion of detailed implementation planning. However, it must be recognised that some unease will remain prior to individual job placements. Massive technological changes over the past 20 years have produced the same fears about job security, but natural wastage and redeployment and retraining have been sufficient to absorb surplus staff, and all the indications are that the same will hold true for NAIP.

HOW NAIP IS MANAGING THE CHANGE

The NAIP structure of Core Team, customer user group (formerly functional working groups), Headquarters project owners, project management office and pilot sites is described in other articles. The Infrastructure and Interfaces Functional Working Group (I&I FWG) was established with tasks including the definition of requirements for 'people' issues, such as industrial relations, training, organisation, employee communications and management of change. A great deal of work was done by this group to establish the foundations of management-of-change principles in this programme.

It was generally recognised that the terms of reference of the I&I FWG extended into operational areas and that a re-focus was required on specific 'people' issues which had been clearly outlined in the NAIP People Vision document. As a result of a major review of the management of the project, the I&I FWG was replaced by the People Working Group (PWG). Building on the principles produced within the I&I FWG, the PWG was established to provide direction to HQ Personnel in order that national policy guidance could be provided as necessary. Under the chairmanship of a District personnel manager and with members including personnel managers from the pilots, HQ Personnel and the NAIP management team, this group is currently seeking to identify ways in which employee problems and concerns can be surfaced and addressed much earlier in the change process. The group's terms of reference, contained in the client requirement definition, indicates a much closer alignment to the project management principles as laid down by the business. Given the make-up of the group, there is also the recognition of the importance of balancing the needs of those initiating change against the needs of those experiencing the change.

As a further recognition of the importance now placed on the human aspects of change management, two full time specialists—in employee communications and management of change—have been appointed as part of the NAIP management team.

Employee Communications

The requirement for employee communication was identified at the outset, and national publicity material (ranging from a glossy brochure, through to *Networker* articles and team briefing packs for use by line managers) has been published since 1988. The objective has been to have an open communication policy, providing the maximum amount of information in a variety of formats to best meet the needs of the recipients.

Much has been learned from local NAIP employee communications experiences. This is particularly so in respect of the pilots where a wide range of initiatives has been undertaken. These included special editions of the District

newspapers, newsletters, open days/exhibitions and management forums etc. A model NAIP employee communications plan has been produced, taking into account feedback which was obtained at all stages of the programme and directed at staff at all levels. In addition, the experience in the pilots has highlighted the need to have effective two-way communication. Consequently, it is intended that this aspect will be built into all future communication initiatives.

Industrial Relations

Hand in hand with employee communications runs the formal industrial relations process. A separate sub-committee of the Network Joint Consultative Committee (NJCC) has been formed to deal with central issues arising from NAIP. Chaired by the NAIP Programme Manager, it ensures that a regular flow of information enables any union concern to be raised at a senior level. One of the requirements of NAIP is standardisation of approach and the NJCC is part of this process. Local consultation has been established to deal with the inevitable site-specific issues.

One of the earliest issues was the need to set up suitable and effective local information and consultation procedures. This was a more complex problem than normal because the NOU catchment areas crossed District boundaries. Both pilots encouraged the BTUC to establish teams made up of representatives from all Districts, and the Trunk Region included in the geographical catchment area. This was achieved and provided valuable experience for inclusion in NAIP industrial relations planning for the national roll-out of NOUs.

Training

Equipping people with the appropriate skills and knowledge to work effectively in a changed environment is a critical part of any change programme. It has been recognised that much training and re-training will be necessary as NAIP progresses, and the aim has been to meet these requirements, by ensuring that existing courses are modified and new courses established at the appropriate time.

Vision Building and Transition Planning in the Pilots

In addition to the co-ordination of management-of-change issues at national level, the pilot NOU sites in the North West and Midlands were concerned with managing change at a local level.

In the North West pilot, managing the changes has been steered by the Personnel and Industrial Relations Group (PIRG), chaired by Manchester's Personnel Manager, Bob Mason, with day-to-day management of the change being the responsibility of Peter Ashcroft, the NOU Manager.

The PIRG was set up six months prior to the opening of the NOU, with the aim of anticipating, planning and resolving the personnel and industrial relations issues resulting from the project. The group comprises senior engineering and personnel managers from the three Districts in the catchment—Liverpool, Lancs and Cumbria and Manchester—with a consultant from Training Department's Management Consultancy Unit helping to address the organisation and people questions.

The starting point for the PIRG was the development of a vision of how people would be working in the future as a consequence of NAIP. Once the vision was established, strategies and action plans for its achievement could be designed, and action taken to start implementing them.

While the PIRG plans ahead, and anticipates the people issues, Peter Ashcroft, the NOU Manager, is directly responsible for managing the change on a day-to-day basis. Not only have there been cultural issues, in terms of bringing together staff from three Districts and changing roles of managers, but there have also been what could be classed as 'hygiene' or comfort concerns, such as car parking and building works. It is often these factors which are crucial to success.

In the Midlands, overall responsibility for managing the project, and the associated people issues, has fallen to the Project Office Manager, Vaughan Armstrong. Identification of these issues is owned by the Level 3 groupings, with meetings of these managers to address the issues.

CONCLUSION

This article has highlighted the need for management of change, and has outlined how this process has been started in NAIP. It is important to recognise that addressing and managing the people issues on NAIP will be an on-going process. To ensure success, this process needs to be owned by managers within the programme, with support being provided to them where appropriate.

Considerable time has been devoted to developing technical and procedural solutions to the administration of the network. Corresponding development of the people and organisational solutions is also essential to ensure that the technology and the organisation are working in harmony to provide the most effective service for BT and its customers.

ACKNOWLEDGEMENT

First and foremost, the authors would like to acknowledge the people within NAIP who have taken responsibility for, and ownership of, managing the changes, and have devoted time and energy to this task. In particular, recognition needs to be made of Bob Mason, the North West

PIRG Chairman; Peter Ashcroft, the NOU Manager in Manchester; Vaughan Armstrong, the Walsall NOU Project Office Manager, and members of the I&I FWG. The authors would also like to acknowledge the contributions made by Mike Briggs, and Henry Thompson in writing this article.

Bibliography

BOWER, M., and WALTON JR., C. L. Gearing a Business to the Future, in Challenge to Leadership. 1973.

EGAN, G. Change-Agent Skills B: Managing Innovation and Change. 1988.

GERSTEIN, M. The Technology Connection. Addison Wesley OD series. 1987.

KARP, H. B. Working with Resistance. *Training and Development Journal*. March 1984.

KOTTER, J. P., and SCHLESINGER, A. Choosing strategies for change. *Harvard Business Review*, March–April 1979.

MARGULIES, N., and COLFLESH, L. A Socio-Technical Approach to Planning and Implementing New Technology. *Training and Development Journal*, Dec. 1982.

MOREAS, G. Un flic de l'interieur. 1985.

KANTER, R. M. The Change Masters.

Biography

Helen Lockhart is a consultant working in Training Department's Management Consultancy Unit. The unit is focused on supporting major change initiatives in BT, using its expertise in the design, implementation and evaluation of purpose-built change management programmes, to ensure cost-effective solutions for each client. Cultural, financial and technological change issue are addressed by the unit, which is made up of consultants with wide-ranging business backgrounds. She has a B.A. in Psychology, and an M.Sc. in Occupational Psychology, both from Queen's University, Belfast. On graduating, she worked for 2 years in the Department of Trade and Industry, before joining BT's Training Department in 1988. She has been in her current position since October 1989.

John Young joined the then British Post Office as a Y2YC in Bournmouth in 1950. He has 28 years network experience, was Midland Region Planning Controller from 1980–84 and is currently Territory Engineer for Central, South West England and Wales Territory. He was a member of the Network Administration Task Force with responsibility for determining network administration concepts. He has a B.Sc. degree in Engineering, is a Chartered Engineer and a Fellow of the Institution of Electrical Engineers.

The Selection of Support Systems for Network Administration

S. P. SAVAGE†

This article describes the selection of computer-based network support systems required to underpin the Network Administration Implementation Programme (NAIP) platform. It also briefly describes the systems selected, their role in the NAIP Platform and the part that they will play in the longer-term evolution plan for network administration.

INTRODUCTION

As defined in a previous article in this issue[1], the aims of the Network Administration Implementation Programme (NAIP) are to improve quality, functionality, and drive down costs associated with the administration of the British Telecom UK network. The NAIP Platform has concentrated on the process associated with the resolution of network faults identified by the customer, the network, or network staff. This is the first stage of a continuous process to improve the administration of the network.

The approach taken by NAIP has been to establish a number of functional working groups made up of both field and headquarters staff. These NAIP functional working groups have investigated the various methods currently used in the field to perform particular high-cost administration operations (for example, to resolve a customer-reported fault) and select a preferred or 'standard practice' to be adopted nationally.

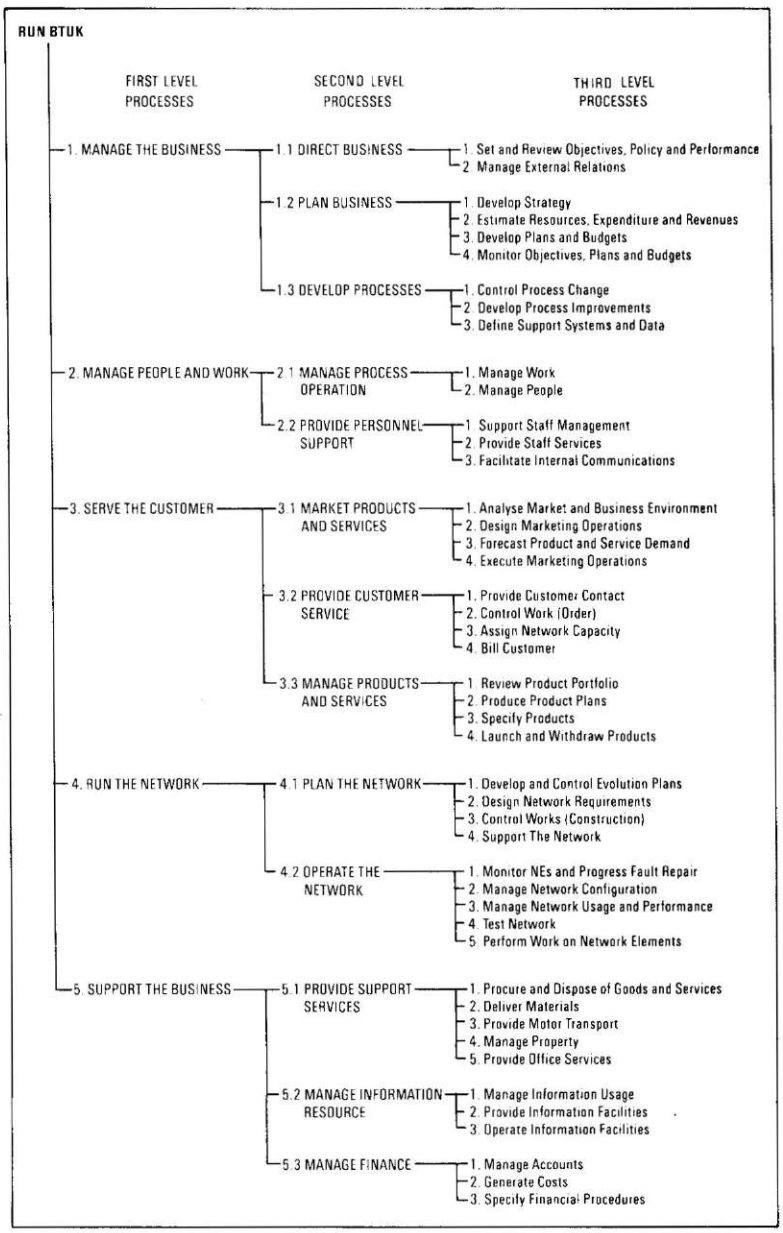
As part of the selection of standard practices, the need to automate or provide computer-based aids has been considered and one or more network support systems chosen for use, where appropriate. Where no existing system was available to meet the needs, the development of network support systems was considered.

RELATIONSHIP WITH SSP AND NCAB

The need to select carefully network support systems for network administration, while making provision for future network needs, has been described in previous articles[2, 3].

The major business initiative influencing the evolution of network support systems is the *Strategic Systems Plan* (SSP)[2] project. This project initially performed a top-down analysis of the working of BTUK as a whole, breaking down what BTUK needed to do in the future to operate as a successful part of British Telecommunications plc. This resulted in a series of layered future processes, each layer describing in progressively more detail a part of BTUK's future operations (Figure 1). Further analysis was then performed against the processes. Where processes had a close affinity to each

Figure 1
BTUK process model



† Network Operations Support, British Telecom UK

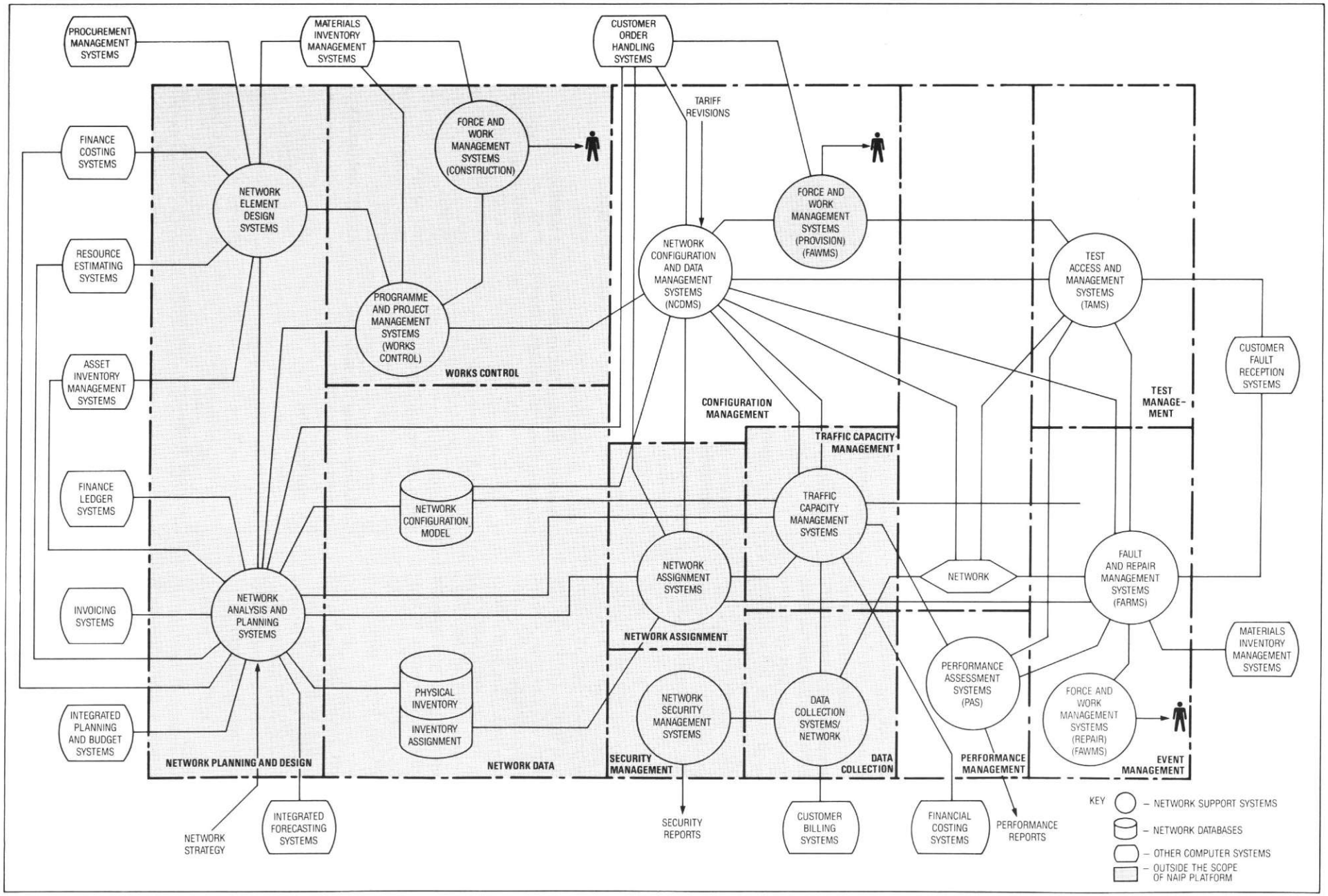


Figure 2 – Network Support Systems Architecture

other in terms of function or data, they were grouped together. Each of those groupings, termed *strategic systems areas* (SSAs), form manageable areas of the business for future automation.

Over 150 different network support systems are in use today within the BTUK network. The operation and management of these many computers is a significant cost to the business. In many cases, network support system functions are duplicated for different parts of the network.

The *Network Control Architecture Board* (NCAB) is responsible for the evolution of network support systems to realise SSAs within the BTUK network and, at the same time, rationalise the many systems to reduce network administration costs. The NCAB has taken the SSP proposals for the realisation of SSAs, together with a number of other influences, and produced a framework (Network Support Systems Architecture) within which network support systems will evolve[3] (see Figure 2). In order to discharge its responsibility, the NCAB is required to give strategic concurrence to all network support system development proposals.

For each SSA, the NCAB has reviewed the existing network support systems that contribute to the SSA, and selected one or more support systems as being best suited to continue to perform functions within the SSA. These selected systems have been termed *key systems* and will form the core onto which network administration computing will be consolidated.

Key systems may currently perform many functions, and hence may be 'key' to more than one SSA. The NCAB intends that the functions performed by non-key network support systems will migrate into key systems. Eventually, the need for non-key systems will disappear and the costs associated with the running of these systems will have been removed. This migration of functionality, onto key systems, must happen in a controlled way to ensure that all necessary network administration functionality is available at all times. Any further development of non-key network support systems will be closely scrutinised by the NCAB before approval is given.

In order to support NAIP, the NCAB has appointed a representative to help each NAIP functional working group to select network support systems associated with standard practices. This ensures adherence to the evolution of the Network Support System Architecture.

SELECTION PROCESS

The selection of network support systems to meet the needs of particular NAIP standard practices involved the assessment of the proposed network support systems against the guidelines outlined above.

Initially, standard practices were assessed to ensure that the boundary of each was enclosed within a given set of SSP processes and that significant functionality would be provided by each standard practice selected.

The requirements identified for network support system functions, for each standard practice, were compared with the SSP strategic system area's functions and interfaces, to ensure that all appropriate interfaces, manual and electronic, were being defined as part of the standard practice.

Where the NCAB had previously identified a key system to perform the network support system functions required, this was examined in further detail to confirm the selection of the key system as the one to support the standard

TABLE 1
Network Support Systems Selected for NAIP Platform

NAIP Platform Standard Practice	Network Support System Selected
TXD Operations and Maintenance	OMC/OMUSS EIR (Local and Trunk) RESPA TRACKER NOMS1 Telecom Gold CRAISE PASTE
Transmission Network Surveillance	TONS/NETMON ECIS DSEA MANUS JNS NOMS1 CAMMS SPUD
Power and Building Environment Services Operation and Maintenance	AMPERE PMS SEMAC STACCS TRACKER PLC NOMS1
Network Control Centre	WILDFIRE Telecom Gold SPUD
Customer-Facing Organisation to/from Network Interface	ARSCC and/or CSS
Circuit Provision	OMC JNS MANUS DSEA CAPPS AXIS
Network Performance Monitoring	OMC/OMUSS EPIC DESS (LTLA) CSS PASTE Telecom Gold TELCARE (new version) EXPRES
Interim Workforce Management	NOMS2

practice. Where the function required was not available on a key system, an interim non-key system was selected or a new development was defined, and a migration path for the function towards a key system was identified.

In a number of cases, software development was required to amend the selected network support systems to permit their use in the NAIP environment. After completion of the selection process, the chosen network support systems and development proposals were presented to the NCAB for endorsement. The systems selected using this process are listed in Table 1.

There are five strategic systems areas within the network support systems architecture that are affected by the NAIP Platform:

(*a*) fault and repair management systems (FARMS),
(*b*) performance assessment systems (PAS),
(*c*) force and work management systems (FAWMS),
(*d*) test access and management systems (TAMS), and
(*e*) network configuration and data management systems (NCDMS).

The position of the SSAs affected by the NAIP Platform, within the overall architecture, is shown by the clear area in Figure 1. Other SSAs, within the network support systems architecture, will be considered either in later stages of NAIP or by other network programmes (for example, Workforce Management Programme).

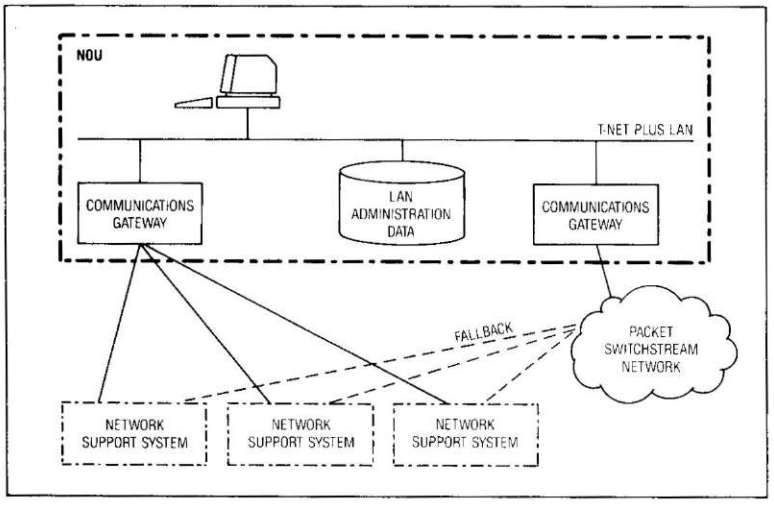
USER ACCESS

In order to provide users with access to the selected network support systems in a coherent manner, a T-NET Plus local area network (LAN) will be provided in each NOU. (See Figure 3.) This LAN is a fundamental part of the NOU structure and will provide flexibility within the NOU for terminal access. A single user, potentially, has access to all the network support systems connected to the LAN from any terminal position, subject to all appropriate LAN administration data being set up. In addition, the LAN allows users to log on to multiple support systems, with access between the systems via a simple key sequence.

As standard practices evolve, and the network support systems to which access is required change, the necessary changes to the LAN can be easily made as minimal physical changes are required.

These LAN features improve the existing situation for many users, by reducing the number of terminals required.

Figure 3
NOU LAN access to network support systems



SELECTED NAIP PLATFORM NETWORK SUPPORT SYSTEMS

Over 30 network support systems have been selected to aid NAIP Platform standard practices. It is beyond the scope of this article to describe all of those selected in detail. Below are described the network support systems which contribute major functions within the NAIP Platform.

Operations and Maintenance System (OMS) and Operations and Maintenance Unit Support System (OMUSS)

The operations and maintenance system (OMS) and operations and maintenance unit support system (OMUSS) are, respectively, the local and trunk network support systems used for the administration of digital telephone exchanges (System X and AXE10). These systems provide facilities to receive and process fault information remotely from exchange sites; perform diagnostics and tests to identify actual faults; and allow a remote user to reconfigure each exchange, to overcome an identified fault. In addition, these systems provide information on the performance of the exchanges that they are monitoring.

The system has been selected to support the standard practices dealing with digital exchange maintenance and network performance monitoring.

Plans are in place to integrate these two systems into a single key system (OMC). The first step in this rationalisation is to make the software on both systems the same; rationalisation of the computers will take place later. This initial step will occur in early-1991.

The OMC is a key system within the FARMS, TAMS, PAS and NCDMS strategic systems areas.

Network Operations and Maintenance System 1 (NOMS1)

The Network Operations and Maintenance System 1 (NOMS1) is a recently developed network support system. The system has been described in some detail in a previous article[4] where it was known as the *alarm collection facility*. NOMS1 is used centrally to collect, filter and display alarms from exchanges, network power and building environmental services plants, and some transmission equipment within an NOU

catchment area. The system also provides access to remote administration facilities for TXE4 exchanges.

This system has been selected to support the standard practices dealing with digital and TXE4 exchange maintenance, network power and building environment maintenance and transmission surveillance.

The NOMS1 system is a key system for the fault and repair management system (FARMS). It contributes to the 'receive faults and status reports' SSP process.

Plans and proposals exist to further enhance the product to receive more extensive alarm information and extend the remote administration facilities.

Customer Service System (Repair Handling)

The Customer Service System (repair handling) is used to transfer customer-reported network faults between the customer-facing organisation and the NOU, and allows the NOU to report repair progress back to the customer-facing organisation. Service-level agreements have been defined for the handling of repairs using this interface as part of the NAIP Platform.

Repair handling statistics are produced on the handling of tasks passed over the interface to allow monitoring of the service-level agreement. This information is also used to aid the measurement of the reliability of the exchanges being managed by the NOU.

Network Operations and Maintenance System 2 (NOMS2)

NOMS2 is a recently developed system that interfaces to NOMS1 for the reception of network fault information. The NOMS2 system is the first-phase work management system. The system holds details of staff experience, current location, method of contact and current tasks in hand. By using this information, all tasks requiring allocation to field staff are allocated and progressed.

The NOMS2 system is part of the force and work management systems (repair) SSA and contributes to the SSP process 'administer force and work'.

Network Monitoring (NETMON) System

The network monitoring (NETMON) system, is used remotely to monitor transmission equipment. It receives alarms centrally and provides the NOU with an indication of the status of all transmission equipment being remotely managed. This aids the location of faults and hence the dispatch of personnel to appropriate sites.

NETMON also provides performance information on the fault rates of transmission equipment being monitored.

This system provides key functionality within the fault and repair management system SSA, particularly associated with the process 'receive faults and status reports'.

It is proposed that an interface be provided to feed NETMON alarms into the NOMS1 system to provide an overall 'picture' of the network from a single display.

Digital Specific Equipment Assignment (DSEA) System

The digital specific equipment assignment (DSEA) system is used to record details of the physical routing of circuits through each transmission node in the network. It contains information on the tie cables used within the node site to connect the various equipment together and details of the physical equipments used. This information is used with other sources (JNS, MANUS) to allow manual correlation and diagnosis of transmission faults.

This system is a key data source for the fault and repair management systems SSA.

Main Network Utilisation System (MANUS)

The main network utilisation system (MANUS) is used to assign and record details of the routing of 2 Mbit/s circuits through the trunk network; typical information includes the primary service being carried over the circuit (for example, public switched telephone network (PSTN), MegaStream), the transmission network nodes (for example, transmission repeater stations) and the transmission equipment at each node used to carry the circuit. This information is used with other sources (JNS, DSEA) to allow manual correlation and identification of transmission faults.

This system is a key data source for the fault and repair management systems SSA.

Junction Network System

The junction network system (JNS) is similar to the MANUS system, but is used for the junction and local fibre networks. It is used to record details of analogue and digital routing through these networks at all levels. This information is used with other sources (DSEA, MANUS) to allow manual correlation and diagnosis of transmission faults.

This system is a key data source for the fault and repair management systems SSA.

A study has been commissioned by the NCAB to investigate the possibilities for rationalisation of the MANUS, JNS and DSEA systems into a single system, the integrated network system (INS).

TRACKER

The TRACKER system is a single-user knowledge base that allows an inexperienced operator to give guidance to similarly unskilled field staff on the diagnosis and repair of faults. The system

contains information on TXD, TXE4, pulse-code modulation (PCM) and power equipment.

This system is a data source for the fault and repair management systems SSA and contributes to the 'provide maintenance assistance' SSP process.

Although this system is not key in the FARMS SSA, proposals are underway to move the knowledge base onto a more flexible computer system to allow multi-user access. This will then allow easier future migration onto a key system.

Exhange Performance Information Collection (EPIC) System

The exchange performance information collection (EPIC) system is used to generate exchange performance information reports. Raw data is collected at various intervals from the MAC and A51 fault detection/recording systems and sent to the EPIC system by the manual initiation of an automatic data transfer mechanism.

This system provides key functionality in the performance assessment systems SSA.

Proposals are being investigated to automate fully the data collection process in the short term. In the longer term, this system is proposed to be integrated into the consolidated network performance system PSCARF.

Service Protection Utilisation Database (SPUD)

The service protection utilisation database (SPUD) system is used as a central system to provide general information on the status of the trunk network. Information is provided on the status of the service protection network, the trunk telephone exchanges and the trunk transmission network. Details of major service failures and planned works that affect the capability of the network to carry traffic are recorded.

This system is a data source for the fault and repair management systems SSA. Although this system is not key in the FARMS SSA, no other system holds the same information.

Performance Assessment System for Trunk Exchanges (PASTE)

The performance assessment system for trunk exchanges (PASTE) is used to obtain data on the general performance (for example, number of isolations, restarts, call failures etc.) of digital trunk exchanges. The system provides key performance information to NOU and HQ staff. This system supports the standard practice for network performance monitoring.

It is proposed that PASTE is replaced by a more comprehensive general performance assessment system—the performance statistics collection and reporting facility (PSCARF)—for which a feasibility study is currently under way.

The PASTE network support system is part of the performance assessment system SSA and contributes to the SSP process 'collect and evaluate performance information'.

Digital Exchange Support System (Long Term Log Analysis) (DESS (LTLA))

The digital exchange support system (long term log analysis) (DESS (LTLA)) system is used to process the large volumes of information produced by exchanges. It is used to provide performance information on the exchange equipment and to aid the diagnosis of faults.

This system provides key functionality in the performance assessment systems SSA and is a key data source for the fault and repair management systems SSA.

Asset Management for Power and Engineering Resources (AMPERE) System

The asset management for power and engineering resources (AMPERE) system is used by network power and building environmental services (P&BES) to manage the routine activities associated with network P&BES equipment. The system contains a fault history for all equipment and is of use in the diagnosis of faults.

The AMPERE system is part of the force and work management systems (repair) SSA and contributes to the SSP process 'administer force and work'. The system is also a data source for the fault and repair management systems SSA.

Equipment Connection and Inventory System (ECIS)

The equipment connection and inventory system (ECIS) contains information on the location and fault history of network transmission equipments and slide-in-units. It is used as a mechanism to transfer fault information to repair centres and provide performance information on transmission equipment. Access to fault history is a useful aid in the manual diagnosis of faults.

This system is a key data source for the fault and repair management systems SSA and provides key functions within the performance assessment systems SSA.

Other Systems

Several other network computing systems are necessary to the success of the NAIP Platform; however, the level of functionality or data that they provide to the NAIP Platform is not as significant in relation to those described above. These systems are listed below for completeness.

DESS (EIR)
EIR (Trunk)
PLC
WILDFIRE
RESPA
EXPRES
REMOS
CRAISE
Telecom Gold

In selecting network support systems for NAIP, the NCAB has successfuly reduced the number of non-key network support systems and prevented action that would limit further savings in the future. It has also resulted in the deployment of an infrastructure, in the LAN, that will allow early benefits to be realised from the future improvement of standard practices.

FUTURE SUPPORT SYSTEM DIRECTIONS

As standard practices evolve and other SSAs are visited, the requirements demanded of network support systems will also evolve. This evolution of network support systems under the control of the NCAB will ensure that the overall number of network support systems reduces, while maintaining a consistent set of network administration functions. All these actions contribute to reducing the costs of network administration.

Initiatives are already underway to further investigate the test access and management systems (TAMS), network configuration and data management systems (NCDMS) and fault and repair management systems (FARMS) SSAs during 1990.

References

1 BEALBY, A. G. The Development of Network Administration in British Telecom. *Br. Telecommun. Eng.*, Oct. 1990 (this issue).

2 BROWN, D. W., BELL, R. C., and MOUNTFORD, J. A. Strategic Planning of Business Operations and Information Systems. *ibid.*, Apr. 1990, **9**, p. 16.

3 SPOONER, M. J., ASH, J. R., and FURLEY, N. J. Network Support Systems Architecture and the Control of Systems Evolution. *ibid.*, Apr. 1990, **9**, p. 28.

4 NEILSON, G. Centralised Exchange Management Using Gateway Products. *ibid., Oct. 1989*, **8**, p. 160.

Biography

Steve Savage is a member of the NCAB Support Team, providing guidance on network support systems issues to the NAIP Operations Support Centre Functional Working Group.He joined BT in September 1982 as a graduate entrant having obtained a B.Sc. degree in Electrical/Electronic Engineering. He worked initially on the data build for early System X and AXE10 digital telephone exchanges, including the development, testing and documentation of computer-based support tools. He has been involved with the project management of the local exchange maintenance and control system (LEMACS), and a member of the project management team for the digital exchange support system (DESS).

Network Administration Support System Development

R. J. HELLEUR, M. J. D. TILLEY, and D. E. HUGHES†

Network management support systems are evolving rapidly from the current fragmented set to the 'hands-free' future of a consistent jigsaw of high-functionality interworking pieces. This article outlines the functional pieces in the 'portfolio', the architectural framework which glues them together, their open systems computing platform, organisational aspects, and future trends.

INTRODUCTION

The technology within the network has advanced through digitalisation of both transmission and switching, and the introduction of computer-controlled network elements. The greater reliability of this technology and the ability to manage and configure the elements remotely has created new opportunities for efficient management of the network.

These opportunitites have been translated into a vision for the future operation and management of the network, initially through the Network Administration Task Force (NATF) and subsequent refinements in terms of architecture (Network Management Architecture), and process (Strategic Systems Plan (SSP)).

THE VISION

The vision can be summarised as:

- end-to-end network management;
- functional coverage of the whole network life cycle;
- fully integrated functionality;
- flexibility—evolution and growth;
- high levels of automation/decision support; and
- conformant to architectural objectives:

(*a*) network management hierarchy,
(*b*) Co-operative Networking Architecture, and
(*c*) open systems platform.

End-to-End Management

It is essential to be able to manage networks made up of elements from different vendors and different generations of equipment in a consistent manner, so that the network can be viewed as a complete entity which provides a managed service platform.

Whole Life Cycle

Networks and services must be managed from 'cradle to grave' (Figure 1), covering:

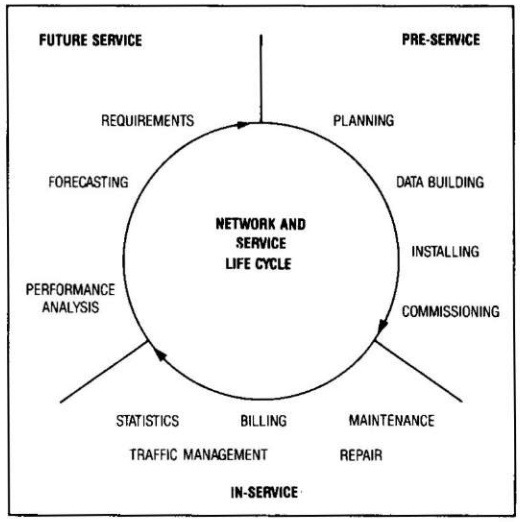


Figure 1—Communications management—life cycles

Forecasting
Requirements analysis
Detailed dimensioning and project planning
Data building
Installation and commissioning
Maintenance/billing/traffic management
Repair
Performance analysis and review
Enhancement/withdrawal

Hands-Free Operation

It is essential to give network managers a high level of automation in order to enable them to cope with the levels of complexity involved, vast amounts of data, apparently random nature of problems, and the need for speed, accuracy and consistency in decision making.

This requires:

(*a*) incidents to be analysed automatically with the manager's concurrence being sought to the solution offered;
(*b*) automatic restoration of service to be achieved whenever possible;
(*c*) jobs despatched to the workforce based on an optimum approach to jeopardy, costs, tactics and company image;

† Network Management Department, British Telecom Research and Development

(*d*) customer's notification of service affected generated automatically to the appropriate customer-facing unit; and

(*e*) performance statistics kept and analysed on all key processes.

DEVELOPMENT CHALLENGES

The challenge for the system developers is to be responsive and meet new requirements quickly, while producing enduring systems which fit within an integrated set—the jigsaw—the whole evolving towards the Network Administration Implementation Programme (NAIP) and SSP vision in a cost-effective manner.

The developers have to move from a position of well over 200 systems, most of which do not interwork, and many of which no longer offer all the essential functions, to a set of around 40 fully-integrated high-functionality *key* systems.

Functions must be brought into line with the required business processes and must evolve to match the demands of new network technologies and topologies. For instance, planning rules for fibre systems must be continually reviewed to encompass increasing capacities and repeaterless operation.

Systems must also take account of the changing operational organisations and procedures, and solutions must be mounted into a computing framework which can evolve without damaging the software investment already made.

Solutions have to be achieved within four planes of change as illustrated in Figure 2.

THE DEVELOPMENT ANSWERS

To meet these challenges the developments must have:

- *Good Overall Architecture* A standard framework to enable consistent interoperable solutions, as explained further in the next Section.
- *High Internal Modularity* To promote reusability and control the impact of change by containing it in well defined pieces.
- *Good Development Tools and Methods* To gain efficiencies and pace.
- *Quality Development and Support Processes* To ensure deliverable milestones are met with confidence.
- *Small Company/Large Company Approach* To enable responsiveness, speed and innovation to take place within a strong quality regime and in tune with strategic evolution paths.

ARCHITECTURE—AS AN ENABLER

What is an Architecture?

An architecture:

- defines concepts and terms for explaining systems,
- provides a model for reasoning about systems,
- provides a base specification for systems building blocks,

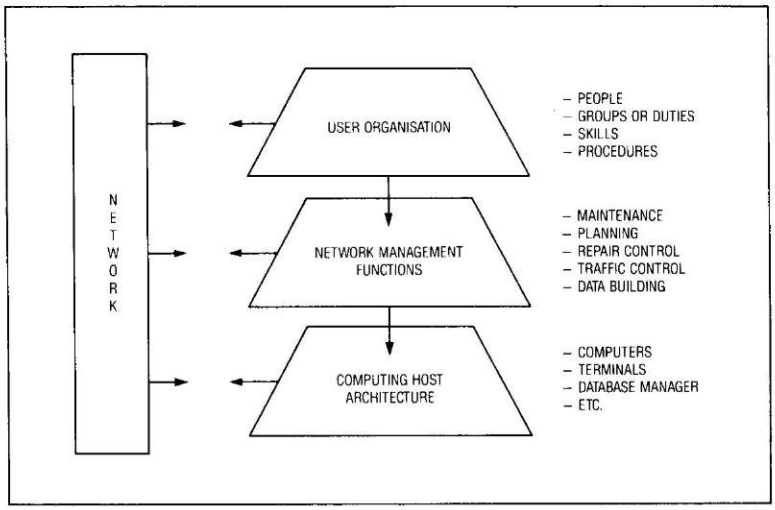


Figure 2 Linked planes of change

- provides a design process for putting systems together,
- defines messages and protocols for interworking between systems,
- decomposes functionality into layers, systems and modules, and
- provides a framework for controlling the evolution of a portfolio.

Without an architecture, each new set of requirements is likely to produce a new support system, often developed with little or no interworking capabilities with other systems, and often built from different software technologies on different computer platforms.

In order to explain the impact and benefits of the architectural approach, each element of the architecture will be described and the way it contributes to the success of systems development defined.

'Business' Architecture

This 'enterprise' perspective concentrates on business process analysis, as employed by the SSP. This has defined all of the processes that are carried out in efficiently running an advanced telecommunication network organisation. By examining how these processes are grouped into logical systems and how each group of processes exchanges information with other groups, so an ideal set of systems and interfaces can be defined.

Network Management Hierarchy

In parallel with the process view of the support systems, a layered view has been defined, pragmatically grouping systems according to their role. Thus service management systems are distinguished from network control systems and element managers. (Figure 3.)

Physical Architecture

The NAIP has created a coherent deployment architecture which deals with the physical placement of hardware and people. The lead article in this issue of the *Journal* describes the concepts

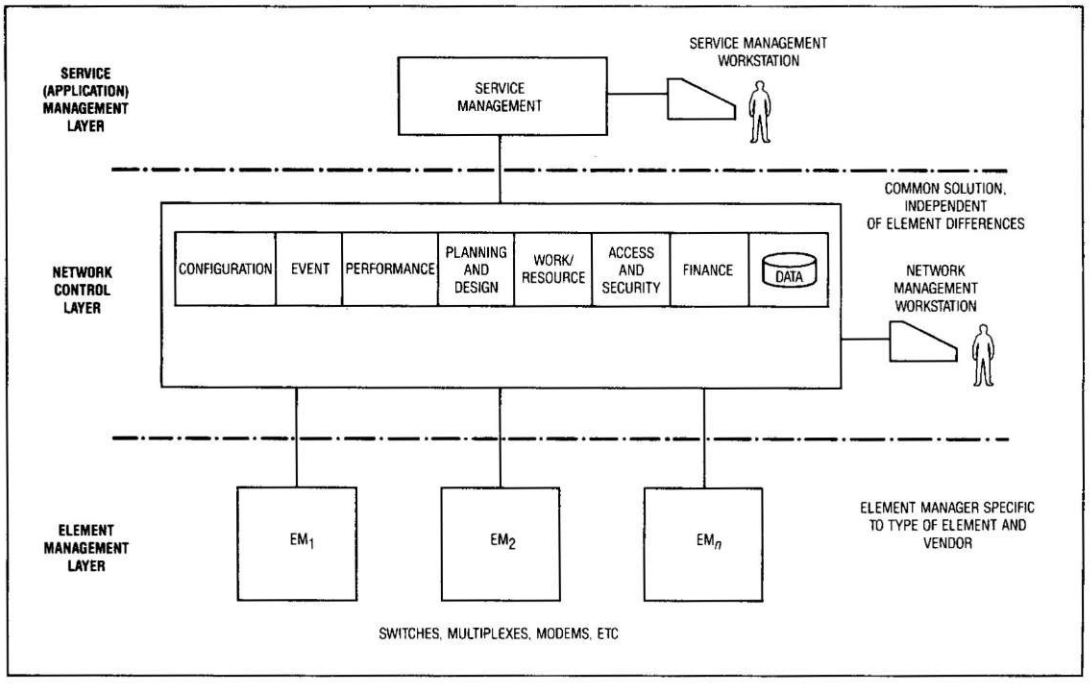


Figure 3
Network management hierarchy

of the network operations unit (NOU), network field unit (NFU) and network administration computer centre (NACC) structures, which are a vital part of the overall architecture.

Interface Architecture

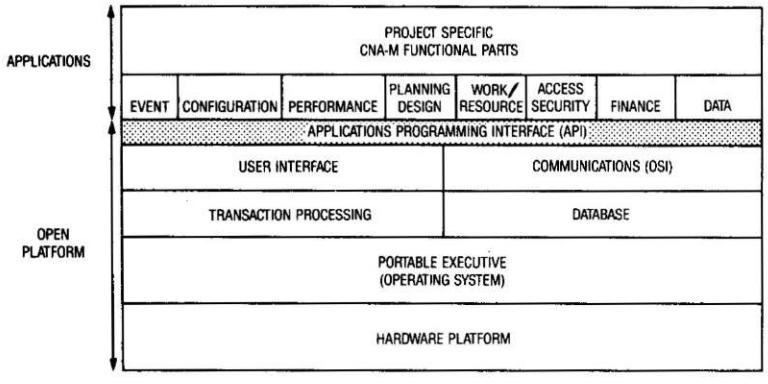
The interface architecture provides the means to link all the pieces of the jigsaw together. By a mix of Open Systems Interconnection (OSI) products and pragmatic proprietary products, (for example, SNA, DECNET), a communications infrastructure will be deployed to connect users to systems, systems to other systems for information sharing, and systems to the network elements they are managing.

Key standards for these interfaces are being defined in the Co-operative Networking Architecture (CNA-M) programme.

Data Architecture

Data architecture offers the ability to standardise what the processes need to talk about. Defining the structure and format of the key information items provides a common currency which may be shared by the complete family of support systems.

Figure 4
Generic Systems Architecture



The object-oriented style of the CNA-Management communications protocols will force the standardisation of objects as well as simple data structures. Work is progressing rapidly on creating the standards in the CNA-M programme and external standards bodies like ISO, CCITT and the OSI Network Management Forum.

System (Computing) Architecture

The system architecture defines how a particular system is constructed, rather than the functional role it plays within the jigsaw.

This deals with the following main components, as illustrated in Figure 4:

- computer hardware,
- operating system,
- database management system,
- transaction processing,
- communications drivers,
- man–machine interfacing (MMI), and
- application programming interface (API).

There is a drive by the computing industry to create standard 'open' interfaces to these elements, based on UNIX/POSIX and X Open standards to produce the *open platform*.

The system developers are also driving towards reusable sub-functions and utilities.

These two initiatives are being brought together in the *Generic Systems Architecture* (GSA).

INTEGRATION AND EVOLUTION

SSP, ONA-M, Generic Systems Architecture and the Network Control Architecture Board (NCAB) 5 year vision for support systems evolution have all contributed to creating a clear picture of how support systems will look in the future. It is important, however, that a very

pragmatic approach is taken to realising this vision.

A balance must be struck between achieving the benefits to be gained from a cleaner architecture and structure against meeting an urgent and genuine business need for improved functionality and integration. The benefit of a clear vision is that it helps to ensure that each step taken moves us closer to our ultimate goal.

The key drivers in evolving BT's support systems are:

- Increasing and improving functionality to reflect changing business requirements and operational experience. The focus will be on value for money.
- To improve efficiency and productivity through the interconnection of existing systems; for example, OMC-CSS, CSS-Workforce Management etc. The growing availability of OSI standards and products will be an important enabler for this activity.
- To reduce the amount of software development for each new requirement by implementing a core of reusable software. This will reduce the time and cost of future developments and improve quality.
- To benefit from the high-functionality high-performance low-cost computing platforms which are becoming available in the open systems arena. This requires the development of applications to rigid portability criteria based on open standards.
- To bring the private network (Concert™) and public network management product portfolios together which will support BT's joint aims of a cost-effective network operator, and a major supplier of network management systems to external customers.
- Reshaping existing systems to conform to CNA, open standards, and the Network Management Department (NMD) Generic System Architecture.

It is important to note two key aspects:

- The targets of functional vision and architectural conformance are moving targets—practical, attainable subsets of these have to be chosen from time to time to give the next realistic goal set.
- Each product in the portfolio will potentially evolve to the next conformance target by a different set of stepping stones and at a different pace from other products.

Fully deployed, large-scale systems (for example, the operations and maintenance centre (OMC)) will achieve interoperability early but will probably delay porting to the open system until late in the programme to avoid waste of effort and to utilise fully existing computing investments.

Indeed, some very stable mature systems may never be ported if their viable life span does not warrant further development and computing costs.

New systems (for example, the network operations management system (NOMS)) will generally be close to full conformance from the outset, and will gradually evolve to synchronise with updated targets.

Utopia will be achieved in small steps.

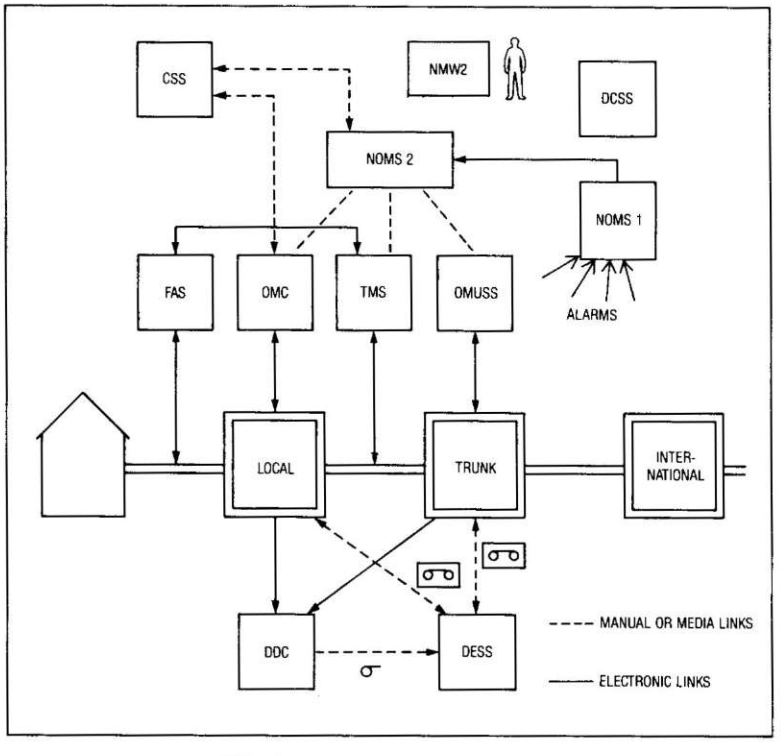
THE PORTFOLIO—JIGSAW

The current portfolio is made up of several loosely coupled key systems, each performing operations and management functions for a part of the network. Figure 5 shows in simplified form how the systems relate to the network and each other.

Switch Management

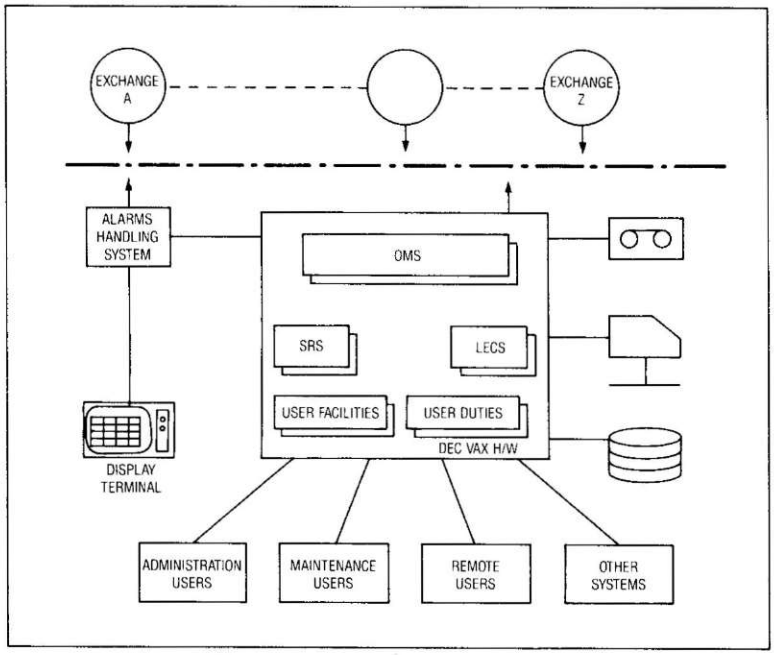
Switch management is carried out by the OMC for local exchanges and the operations and maintenance unit support system (OMUSS) (an OMC derivative) for trunk exchanges. This system has clocked up over 3000 system months of reliable service since its introduction in 1984. As the first major network management system, it has paved the way for the NACC/NOU structure.

There are over 60 systems in field service, with over 10 000 registered users, covering all



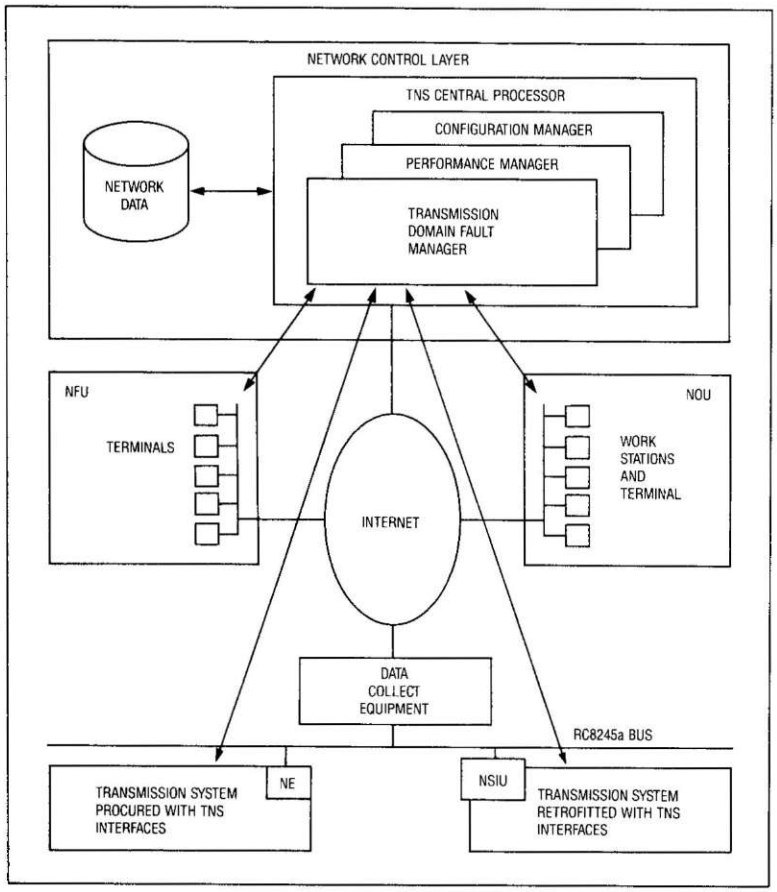
CSS: Customer Service System
NMW2: Network management workstation
DCSS: District control support system
NOMS: Network operations management system
FAS: Fibre access system
OMC: Operations and maintenance centre
TMS: Transmission monitoring system
DDC: District data collector
DESS: Digital exchange support system
OMUSS: Operations and maintenance unit support system

Figure 5—Relationship of current operations and maintenance systems to network



OMS: Operational maintenance system
SRS: Subscribers record system
LECS: Local equipment computer system

Figure 6—OMC2: schematic



NSIU: Network system interface unit

Figure 7—TNS architecture

trunk and local System X and AXE switches. Enhancement continues to run at a considerable pace, working its way into the field through two major releases per year.

Figure 6 shows a schematic of the OMC. The system provides a user-friendly interface to maintenance and administration users, shielding them from the vagaries of the exchange interface. The alarm handling system (AHS) provides an alarm collection facility which offers additional security and cross-checking of alarmable events.

The system is based on a VAX/VMS platform with Oracle relational database, its own basic forms/menus man–machine interface and X.25/V.24 communications drivers. The exchange interfaces are controlled through flexible data-driven translators and the basic structure of the system is highly modular.

The priority evolution steps for OMC are:

(*a*) interoperability with CSS, the transmission network surveillance (TNS) system and workforce management (NOMS2),

(*b*) additional exchange interfaces for advanced services unit (ASU), etc.,

(*c*) adoption of advanced workstation (NMW2) man-machine interfacing, and

(*d*) donation of functions to Generic Event Management (GEMS).

The porting of this system to an open platform will remain low priority until it is essential to replace the NACC computing base.

Transmission Management

The transmission monitoring system (TMS) provides a comprehensive surveillance system for the transmission aspects of the network. While the OMC manages a smaller set of complex network elements, the TMS faces the challenge of collecting, collating, and displaying information from a vast array of physically dispersed components.

After field-trial stages and recent product trials in London, the TMS is now being rolled out into the three pilot NOU catchment areas.

The TMS will evolve in the next 12 months to become the more advanced transmission network surveillance (TNS) system. Some of the major TNS functions are:

(*a*) alarm reception, display, filing, retrieval and archiving;

(*b*) alarm association and comparison;

(*c*) performance data processing and display (text and graphical); and

(*d*) access to other systems (for example, the junction network system (JNS) database).

Figure 7 gives a schematic of TNS. Connections to the network are focused into the central operational support system (OSS) by a network of primary collect equipment (PCE), packet assembler/disassembler (PAD) and front-end processors (FEPs).

TMS/TNS is again based initially on VAX/VMS architecture, with many basic functions reused from the OMC.

The priority evolution steps for TNS are:

(*a*) interoperability links to JNS (and the network equipment allocation system for the proposed British Telecom International deployment), OMC and NOMS2;

(*b*) basic correlation functions;

(*c*) adoption of NMW2 man–machine interfacing; and

(*d*) porting to open platform when cost effective to do so.

Local Access Management

The flexible access system (FAS) is a system which has been developed to manage fibre in the local loop. Systems have been installed for the City Fibre Network and Docklands.

The support system, the service access control centre (SACC), once more shares a common lineage and technology platform with OMC combined with the ICENI database produced by NMD, and used as an element in the service desk and facilities management systems.

FAS was the first system to attempt to adopt the network management hierarchy, with well-defined interfaces between the service access control centre (SACC) (network level controller) and element managers developed by the equipment suppliers. It also adopted the network management workstation (NMW1) to remove a multitude of various terminals.

Until the future of the FAS is fully determined, the SACC will not be enhanced and evolved. However, the structure of future advanced local access management is being considered based on experience from FAS, LLOFT (the Local Loop Optical Fibre Trial) and cable TV management.

Data Management and Performance Analysis

The digital exchange support system (DESS) consists of many applications which are grouped together under a single code name. Some of the functions these applications perform are:

(*a*) data build for new exchanges and major upgrades;

(*b*) generating network performance statistics by analysing the large volume of data generated by switches;

(*c*) providing a national reference source for charging information, and associated validation tools to ensure charging integrity;

(*d*) providing a database and tracking mechanism for all exchange incident reports; and

(*e*) a register of the hardware and software build levels for all exchanges in the network.

DESS is a major system which runs on one of the largest VAX cluster configurations in the world. It supports a population of 2000 users, 140 of which may be simultaneously logged into the system. A typical daily workload for DESS would be analysing 1·4 Gbyte of exchange generated data, producing 35 thousand pages of printout, and writing or reading 1500 exchange cartridges.

The key evolution targets for DESS are:

(*a*) to provide faster communications links to users, and

(*b*) to widen data management and performance analysis functionality.

Moving to the open platform will be a low priority until the current computer investment needs to be replaced.

Alarm Management

The network operations and management system (NOMS1) collects alarmable events from a number of sources, including power and buildings.

It is implemented on M6000/UNIX equipment and shares a common display design with the alarm handling system (AHS) of OMC.

NOMS1 will evolve to become the standard alarm collection mechanism, will adopt the full CNA architecture, and will be linked into NOMS2.

Work Management

Decision support systems have been added on top of the basic surveillance and control infrastructure represented by OMC, TNS and FAS/SACC.

DCSS is a PC-based product concerned with out-of-hours workforce management. Incidents are entered manually into the system, which automatically selects the appropriate member of staff to carry out the task and pages him/her. While originally intended to handle network tasks, the system is used to handle other events such as motor transport, publicity etc. This system has proved invaluable during periods of high workloads such as those generated by major storms.

This system was introduced in 1988 and is now in nationwide use. It will eventually be encompassed in the evolving NOMS2 and work management development.

NOMS2 is a comprehensive work management system and is an example of how a corporate research project has rapidly been pulled into a quality field system for deployment in network operations units. NOMS2 currently provides:

(*a*) a comprehensive resource roster giving full details of all available staff;

(*b*) a database of all tasks which have to be dealt with by the workforce;

(*c*) a set of work allocation tools which allows the distribution officer to assign tasks quickly and effectively to the appropriate individuals;

(*d*) automatic monitoring facilities to check on jobs which are approaching, or are in, jeopardy; and

(*e*) the generation of worklists for each member of staff.

Having been field trialled in the West Midlands, NOMS2 is now being rolled out nationally. The system has been developed as a generic work management system and is being enhanced to cover other workforces such as installation and repair, and will represent a key part of the work management pilot in East Midlands during 1991.

The system is the first to be built with object-orientated design, using an open platform and with INTERNET communications. It will evolve to be fully conformant with CNA during 1991/92.

User Interface

The network management workstation offers powerful windowing workstation functions capable of displaying and manipulating information through an interactive multi-window display.

Such a workstation is becoming essential to allow staff in the NOU to access, update, and correlate information from a number of different sources. The ability to transfer data without re-keying and to cross-check multiple views of information ensures quality and saves time.

Because this is a recent product, it complies with ONA-M and open systems standards such as POSIX, X11, and T-NET. This shows how network management systems are rapidly evolving to meet open architectural goals.

Electronic Information System

The electronic information system (EIS) allows NOU staff to access information in electronic form. It will replace the large number of reference manuals which are difficult to access, slow to update, expensive to reproduce, and often presented in different formats. By providing the ability to rapidly cross reference, index and search, staff will be able to access the appropriate information they require to make an effective decision.

EIS is still undergoing field trials.

FUTURE

A growing influence over the next few years will be seen from the use of knowledge-based systems and, more generally, advanced information processing. These techniques will be applied to decision support functions throughout network management.

Initial simple versions have already started to show through in NOMS2 and EIS. More complex approaches are at the demonstration stage and will soon reach field products particularly in respect of event correlation, traffic management and planning aids.

ORGANISATION FOR SUCCESS

There are some essential organisational aspects to achieving successful systems developments:

Partnerships Given the pace of change and the complexity of the various threads which must be woven together, it is increasingly vital that all developments are created and steered by a collaboration of Headquarters, field and development staff, within the guiding framework of NAIP/NCAB.

Whole Life Cycle Solutions Systems need to be managed from the 'cradle to the grave', with the above partnership operating throughout. Continuous review and field assessment is needed to ensure that systems continue to provide adequate service, and that users are trained to get the best results from these investments.

Phased Delivery A regime of phased deliveries, normally on a 6-monthly cycle, is recommended to provide the earliest added value and facilitate inter-working tests, procedure updating and staff training, by dealing with these in controllable tranches.

Strong Emphasis on Requirements Analysis It is vital to obtain clarity in requirements, including essential functionality, performance targets, level of conformance and supporting attributes such as resilience and security. Fast prototyping and quality tick lists are increasingly helping with these issues.

Good Methods and Tools Developers are continually improving the methods and tools used to support all stages of the life cycle, and are increasingly using metrics to identify those areas ripe for further improvements.

Key target areas, currently, are requirements analysis and system testing, but, as reusability increases, the need for very sophisticated change and version control tools will grow.

Quality, but Responsive BT developers either have, or will imminently acquire, BS5750/ISO9000 accreditation for their quality management systems. This brings a recognised and consistent formality to the operation of the methods and is an essential framework to avoid failure.

However, it is also important not to stifle fast low-cost initiatives to deal with hot-spot problems with lighter-weight quality controls.

CONCLUSIONS

This article has outlined the target vision for support systems offering 'hands free' network management. It has also indicated the number of drivers and planes of change affecting the production of viable cost-effective solutions which gradually approximate to that vision.

The current portfolio of systems already has high functionality, which will provide a very sound base once interoperability has been achieved; this should show through into the field in 1991/92.

The enabling nature and multi-dimensional aspects of architecture have been sketched, and the fact that such targets as the open systems platform are continuing to change with time has been outlined.

Evolution issues have been addressed and some of the key systems in the portfolio have been outlined and their individual evolution paths sketched.

Finally, and most importantly, the key facets of organising to achieve successful systems have been considered.

Biographies

John Helleur is General Manager of the Network Management Department at British Telecom's Research and Technology laboratories at Ipswich. He joined the then British Post Office (BPO) from university in 1969. From 1973–1984, he was involved with the development of the System X advanced switching system in collaboration with Plessey, GEC and STC, including fault tolerant computer design; software design principles; software life-cycle and project management; call processing, overload, maintenance and statistics and subsystem development; and software development facilities (development and operation). He was responsible for launching the embryo Network Management unit in 1984, from which point it has been grown to a department of over 600 staff.

Mike Tilley joined the then BPO in 1966 as an apprentice in the Portsmouth Telephone Area. After spells on circuit provision and external planning, he took a minor award which resulted in an honours degree in Computer and Communication Engineering from Essex University in 1979. From 1979–1981, he worked on System X development, followed by three years as one of the designers of the operations and maintenance centre (OMC2). He left the OMC team in 1984 to join the Software Engineering Department where he specialised in computer-aided software engineering, integrated support environments, and technology transfer. He recently rejoined the Network Management Department as Division Manager Field Support Products and Services.

David Hughes is a Head of Section covering architecture and portfolio evolution in BT Research and Technology's Network Management Department. After graduating from UMIST in 1981, he joined the System X Processor Development Section. On promotion to Level 2 in 1984, he joined Standards Department and helped establish what became Open Network Architecture (ONA). As Head of the ONA Technical Support Group, and later the Communications Management Interface Architecture Group, he worked on the creation of the OSI Network Management Forum (OSI/NMF) and the ONA management architecture initiative. In 1989, he joined Network Management Department to concentrate on the application and implementation of the Network Management Architecture in BT's products, internal systems and services.

The Network Field Unit—Its Role, Definition and Operation

P. W. BLAKE†, and P. G. S. LAMB*

The network field unit (NFU) forms one of the three tiers of the evolving Network Administration Implementation Programme which is designed to provide a range of systems to support and administer a high-quality digital network. This article describes the relative roles of the NOU and NFU, and the criteria to be used when determining NFU boundaries. It also outlines the methods to be adopted for allocating work to the field force under the control of a work management system and describes the evolutionary arrangements to be adopted for communications between the NOU and NFU.

INTRODUCTION

The Network Administration Implementation Programme (NAIP) is designed to reduce costs and improve service to the customer by establishing the following principles for managing the BT network:

- separation of customer service management and network management while maintaining clear and effective links between them;
- standardised provision-of-service procedures for all services, utilising common systems, single-point end-to-end allocation and automatic pre-testing;
- a standardised fault reporting and testing system with open access and communications between network and service organisations;
- a single network encompassing all existing network functions/organisations and services; and
- hands-off administration with automation of activities and faster response times.

The establishment of a three-tier operational structure, covering all networks, is fundamental to NAIP. The three-tier structure (Figure 1) comprises:

Central Operations Unit (COU) where national operational functions, which need to be undertaken from a single centre for the totality of the network, are performed.

Network Operations Units (NOUs) comprising around nine operational centres nationally, strategically sited, from which all aspects of network performance are controlled.

Network Field Units (NFUs) comprising up to 50 geographical management areas containing field teams dealing with all tasks requiring physical presence at network plant locations.

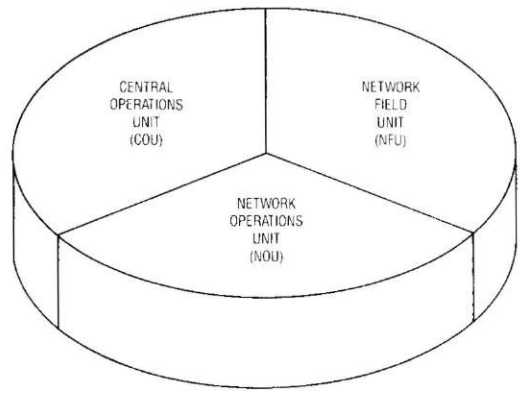


Figure 1—NAIP organisational structure

Other articles in this issue of the *Journal* describe the fundamentals of NAIP and the roles of the COU and NOU. The purpose of this article is to describe the role of the NFU within the overall NAIP structure.

THE NETWORK IN 1995

To assist in gaining an understanding of the objective in creating NFUs, it is important to appreciate how the network will have evolved by 1995 when NAIP will be fully implemented and effective.

The public switched telephone network (PSTN) will be based on a highly-functional digital mature network based on relatively few high-capacity super-nodes supported by an overlay network of intelligent databases. With the exception of the Telex service, all other services, such as those provided by private data networks, derived services network and private service overlay networks, will be digital, or will at least have some of the features offered by a digital network. Some access will be via fibre, others will be via customer or street-furniture multiplexers. Approximately half the network will be used for carrying private services. Synchronous digital hierarchy (SDH) will be the basis for a fully managed transmission network.

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* Network Operations Support, British Telecom UK

Approximately 20% of customer connections will be served by enhanced TXE4 exchanges which will have the ability to emulate, as far as the user is concerned, the characteristics of digital exchanges.

Customer access to the PSTN is still likely to be over a predominately copper-based local loop, which will be well developed as far as capacity and serviceability are concerned. There will, however, be a fibre architecture available to service all principal business parks and provincial city centres. Fibre/street multiplex technology will become the emerging bearer medium for integrated service provision in large urban conurbations. Also, some of the short-haul overhead plant and customer apparatus internal wiring will be eliminated by the expansion of telepoint technology and cordless telephones.

Plant will be of a high reliability, with the ability to be monitored and administered remotely from a single centre covering a large geographical catchment. Much of the decision taking, work planning and management functions will be automated leading to a reduction in overhead support costs for the administration of the network. Capacity monitoring will also be automated along with much of the fundamental network planning activities.

As far as customer perception is concerned, the network will be transparent to all the functional networks or services provided.

An evolving network, as described above, with inherently more-reliable equipment and capable of being managed from a centralised operational centre, requires a fundamental re-appraisal of the roles and responsibilities of operational field teams, together with a review of how best to organise and manage the tasks required to be undertaken at network plant locations.

This review has resulted in the development of the NFU concept as described in the following paragraphs.

THE ROLE OF THE NETWORK FIELD UNIT

The NFU is essentially a geographical area which contains the network field force and managers who are responsible for undertaking all tasks requiring physical presence at network plant locations. Work prioritisation, scheduling and tracking will be controlled from the NOU. It is based on a management structure that reflects the work load of the geographical area rather than an accommodation centre in the traditional sense. The role of the NFU management will be to supervise people undertaking work directed to them via a manual or automated work management system. The work can be originated from the NOU, customer-facing centres or from some other unit in BT requiring work to be carried out by the NFU field force, but all work will be received from a single distribution point located in the NOU.

RELATIVE ROLES OF THE NOU AND NFU

The evolving digital network has been designed with remote administration capability and the NOU will monitor the network and be the sole point for receiving fault reports from customer-facing units. The NOU will direct field staff, via an automated work management system, either to maintain service or to increase network capacity to meet growth. It will specifically replace all the variety of network control centres established over many years.

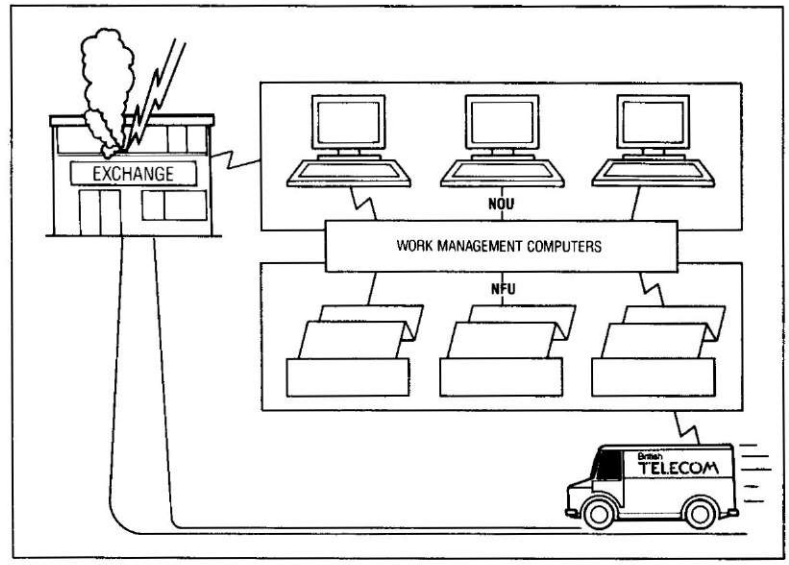
The NOU will, therefore, have overall responsibility for serviceability of the network and quality of service. However, it can only discharge this responsibility in co-operation with the NFU. Thus, although the NFU does not have a direct responsibility for quality of service and serviceability, it will make a highly significant contribution to network performance. It will be essential for the relative roles and responsibilities of the NOU and NFU to be clearly defined and agreed. Some of the parameters to be used for measuring relative performance and efficiency of the NOU and NFU are described below.

Figure 2 illustrates the relative roles of the NOU and NFU, whereby the NOU detects a fault condition, identifies relative priority, identifies an available member of the NFU field force with appropriate skills and in a suitable location and directs him/her to the required network plant location with specific advice regarding corrective action to be taken.

NOU/NFU PERFORMANCE CRITERIA

As indicated above, the NOU will be responsible for the overall quality of service given by the digital network and will direct and control all activities on the network. The NFU will be responsible for providing a highly trained workforce, skilled in a wide range of tasks and specialisms, and undertaking hands-on activities at network plant level to a very high quality standard.

Figure 2 NOU–NFU relationship



The NOU and NFU organisations will each be required to meet a defined range of performance criteria in order to achieve the overall network quality-of-service standards. Typical criteria for digital exchanges are identified below:

NOU Performance Criteria

Processor down time
Customer-reported faults per exchange connection per annum
Exchange faults (MSS failures)
Test call failures (derived from internal system measurements and measurement and analysis centre (MAC) statistics)
Telcare results
Percentage of customer faults processed within 15 minutes

NFU Performance Criteria

Percentage of tasks started in 1 hour from issue to field
Tasks completed per man per day
Maintenance cost per exchange connection
Percentage repeat faults
Percentage exchange connections provided by customer-required date
Percentage faults cleared in 2 hours
Clearance time for Service Care customer faults

The above criteria are examples of those which will require development with the aid of support systems to enable all defined performance statistics to be clearly quantified, measured and published.

MULTI-SKILLED WORKFORCE

A mobile multi-skilled workforce responding to work allocated to them from a work management system is part of the vision of a fully operational NFU. The convergence of technology, its reliability and deployment are driving the network field force in this direction. Multi-skilling can be achieved in many ways; for example, across technologies or across functions.

The introduction of a multi-skilled field force will be an evolutionary process which is planned to be introduced progressively throughout the period during which NAIP is implemented between now and 1995.

It is important to recognise what is meant by multi-skilling. It does not mean that each technician will be expected to undertake all field tasks, but rather that his/her skills will be used wherever they are appropriate and where the relevant training has been provided. It will enable people to take on a wider range of tasks and so enhance their job satisfaction.

The key enablers which will assist the introduction of multi-skilling are:

- development of an appropriate training programme;
- work management systems;
- availability of expert or knowledge-based systems and appropriate support systems;
- good industrial relations, utilising and building on current re-patterning agreements;
- development of a culture change throughout the field force by a programme of communication and education; and
- availability of appropriate up-to-date documentation and procedures.

A single multi-skilling scenario is not beneficial throughout the network organisation and a flexible approach will need to be adopted taking due account of factors such as NFU size and density, system mix, rural geographical considerations, existing skill base, and availability of expert systems, training courses and technical support.

Three types of NFU can be identified, which are explained further in this article. They are:

- rural,
- urban, and
- city.

The level of multi-skilling which can realistically be implemented will be maximum in the rural environment and minimum in the major city locations.

ROLE OF THE FIRST LINE FIELD MANAGER

Traditionally, field managers have either operated in a service/maintenance or provision/works environment. The works manager is responsible for carrying out a programme of work which is dictated by others; the basic function is to execute the plan in the most effective way taking quality and cost into consideration. In the case of the maintenance manager, whose current function is to maintain the grade of service, the situation is different in as much that maintenance activities are part reactive and part pre-emptive. The maintenance manager has had the responsibility for leading the maintenance effort with a view to pre-empting customer-reported faults.

The role of the maintenance manager will change significantly with the implementation of NAIP, introduction of network surveillance and work management systems and will, in fact, align closely with that of the works manager. The overall role of the field manager will be:

(*a*) to ensure that work as directed by the work management system is carried out effectively, safely and within required time-scales;

(*b*) to ensure that work is undertaken to the agreed quality standards;

(*c*) to ensure that the field force is trained to meet the changing demands for skills;

(*d*) to ensure that the field force is deployed in an optimum manner to meet the required response times;

(*e*) to lead, motivate and appraise the field force;

(*f*) to be technically proficient in the field of work he/she is responsible for; and

(*g*) to ensure that a minimum pool of technicians is available to attend to network task requirements.

NFU BOUNDARY SELECTION

Boundary Selection Principles

Mention has already been made in the Introduction that NAIP would involve the creation of around 50 NFUs. Each NOU catchment area will be responsible for determining the optimum number of NFUs within the NOU catchment boundary, taking due account of a number of predetermined criteria.

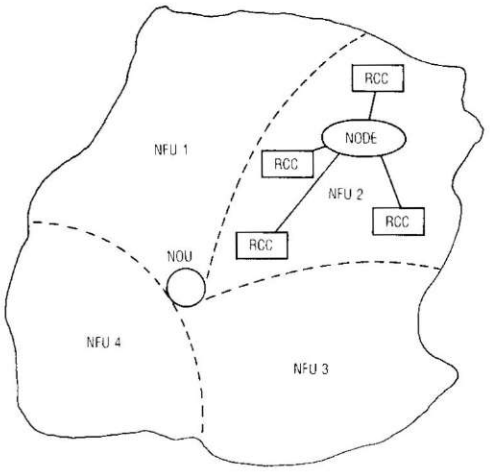
The embryonic NFUs of 1990 cannot hope to have the features and network-wide responsibility that they will ultimately have in the late-1990s; they will be limited by the old technology still in use in the network, the multiplicity of overlay networks currently used to provide various BT services, the inability of the NOU to oversee the entire network it controls, and by the existing demarcation of work and skills.

When NFUs are initially set up they will contain the field force covering all disciplines: works, maintenance, frame management, circuit provision, power, etc. Only a fraction of the field force will initially receive their work from the NOU (limited by the availability of appropriate support systems). Disciplines outside the scope of initial NOU functionality will continue to receive work from their existing controls.

Although only a small proportion of the field force will initially be directed from the NOU, consideration will be given to all work disciplines when determining initial NFU boundaries. This will ensure that future revisions are minimised and the NFU organisation is sufficiently robust to evolve step by step towards the ultimate arrangement.

It is anticipated that the number of NFUs will reduce as the network is progressively modernised towards the 1995 vision, and the NOU is provided with more advanced network oversight and communication with the field force.

It is considered that the ultimate method of dividing up the NOU catchment area into NFUs is to provide a self-sufficient mix of people able to undertake all field works, maintenance, circuit provision and customer-connect tasks within each NFU. This arrangement will provide the optimum potential to accrue the benefits from a fully multi-skilled workforce. Figure 3 shows a typical configuration. Thus, ultimately, the catchment should not be divided into overlapping slices specialising in particular functions—one of the objectives of NAIP is to produce a single network field force. A possible exception to this concept could apply in major city centres such as London where the work volumes could justify the deployment of specialised field force teams.



RCC: Remote concentrator centre

Figure 3—All skills contained within each NFU

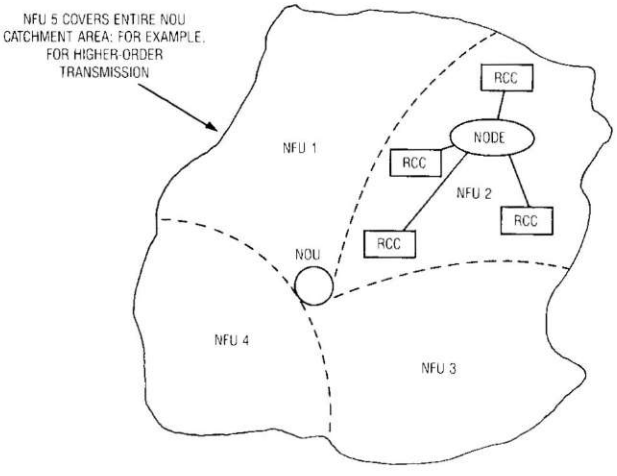


Figure 4—Semi-functional NFUs

During the early stages of the evolution of NAIP, where transmission support systems within the NOU will be limited, there could be benefits obtained in terms of fast response to customer faults from adopting an NFU for the entire NOU catchment area for the field force involved in long-haul higher-order transmission routes (see Figure 4). This will enable these functions to be controlled by a single management structure across the NOU catchment area.

Both of the approaches described above will be trialled in the NAIP pilot areas.

Boundary Selection Process

NFU boundaries will be determined by the application of a decision analysis process which takes due account of the criteria identified in the next paragraph against predetermined objectives such as

- minimum cost,
- speed of response to customer demands,
- short lines of communication and control,
- optimising potential for multi-skilling,
- consistency with NAIP objectives,
- consistency with processor node boundaries,
- optimum skills distribution.

Boundary Selection Criteria

The selection criteria to be considered when determining NFU boundaries are:

(*a*) *Transport Infrastructure* The needs of a mobile workforce must be carefully considered. Road links will be sparse where natural features, such as moors, rivers, mountains and flatlands, predominate. Travelling times will be affected by seasonal variations which include inclement weather, tourist seasons etc.

(*b*) *Rural/Urban Features* NFU areas should be classified as rural, urban or city to enable due account to be given to the number and density of exchange connections and business/residential mix. The degree of field force specialisms will vary depending upon this classification. In the rural environment, the field force will have a wide range of skills and serve a larger geographical area.

(*c*) *Discrete System Types* Various mixes of equipment are used in the network and, although one of the objectives of NAIP is to establish a field workforce capable of carrying out all envisaged work, individual teams within that workforce will be required for some specialised network elements. The geographical location of all equipment types needs to be considered and, where possible, similar equipment should be grouped into the same NFU in order to minimise the number of specialised teams.

(*d*) *Workload by Activity* It is desirable to achieve approximately equal work loads for each NFU and overall work activity should be determined for the catchment area of each remote concentrator centre (RCC). This will indicate where work is concentrated in the current business and enable future requirements to be deduced.

(*e*) *Node Consolidation* The node consolidation exercise undertaken on the digital network was based on criteria similar to those recommended for NFU boundary selection; that is, analysis of traffic patterns, community interest, customer service and geography. It is expected that NFU boundaries will be coincident with processor node catchment areas or multiples thereof.

The actual size of NFUs will vary depending on the application of the above criteria to particular circumstances, but the optimum size should also be found to provide the greatest cost reductions and best quality of service, while providing an effective management structure.

The minimum size will be such that there is a smooth work flow for all specialisms. It must be of sufficient size to have the range of skills necessary to work on all specialist network equipment within its boundary and to operate effectively during periods of holiday and sickness.

The maximum size will be determined by the objective of an effective management structure together with the practical range over which a mobile workforce can operate efficiently.

It is expected that there will be typically four to six NFUs per NOU catchment area with the management structure approximating to a Level 3 management load.

NFU SUPPORT SYSTEMS

The availability of support systems which impact directly on NFU operations will be limited during the early phases of NAIP. Ultimately, expert knowledge-based systems will be available with the potential to improve service by reducing speed of diagnosis and will direct maintenance engineers on first line fault diagnosis.

A work management system is being designed to automate the process of collecting, analysing and correlating network tasks from network plant surveillance equipment and fault reports from the customer-facing organisation.

It will assess priorities, provide jeopardy controls for identification of contractual repair times, and allocate, control and distribute work in the form of tasks to the most suitable resource. Work or task allocation will be based on many factors including staff whereabouts, skills, task priority and individual work lists.

NETWORK OPERATIONS MANAGEMENT SYSTEM (NOMS)

A work management system known as the *network operations management system* (NOMS) will be available in embryonic form during the initial stages of NAIP.

NOMS will be used within the NOU for collecting, filtering and prioritising alarm incidents and then allocating work out to the NFU field force.

It comprises two elements:

(*a*) *NOMS1* is an alarm collection facility bringing together the Gateway and alarm handling systems. Initially, NOMS1 will collect all digital and analogue exchange alarms, together with power alarms.

(*b*) *NOMS2* is a multi-user work management system developed at British Telecom Research Laboratories and is based on the single-user District control support system (DCSS) currently used by a number of Districts and Regions for call-out control purposes. For the initial phase of NAIP, NOMS2 is restricted to issuing tasks to staff working on TXD and TXE4 exchanges, transmission and power during normal working hours and all network faults out of hours.

Thus, NOMS1 will automatically log TXD and TXE4 network equipment alarms, and NOMS2 will capture this information from NOMS1 as well as accepting manual inputs, and will allocate, control and distribute work to the most suitable member of the NFU field force taking due account of staff whereabouts, skills, task priority and individual work lists.

Transmission and power and building engineering services work will have restricted control via NOMS2 during the initial phases of NAIP because of limitations in the current availability of surveillance, support and communication systems.

NOMS will maximise the benefits of centralised test and monitor facilities and allow for the utilisation of a multi-skilled workforce within a modern network operational environment.

Figure 5 illustrates the methods to be adopted for task handling between receipt of fault reports in the NOU and analysis and allocation of tasks from the NOU to the NFU for the various network plant categories.

NOU–NFU COMMUNICATIONS

For the initial phase of NAIP, no new communications facilities will be required between the NOU and NFU because the existing operations and maintenance centre (OMC) and Customer Service Systems (CSS) terminals in the field should be adequate to cope with the limited range of network equipment controlled by NOMS2.

Members of the field force will be alerted to a task issued on NOMS2 via message pagers which will direct them to the nearest OMC or CSS terminal for further detailed instructions. There will be a menu option available for OMC users to provide access to the NOMS work lists. The front-end processor in the network administration computer centre (NACC) will link the terminal to the OMC or NOMS2 processor. Figure 6 illustrates the communications network to be used for the initial phase of NAIP.

All members of the field force who receive work via NOMS2 will be required to log onto the system as their first task each morning to register availability for work and to receive their work list. They will also be required to log their location each time it changes to enable NOMS2 to maintain an up-to-date whereabouts list.

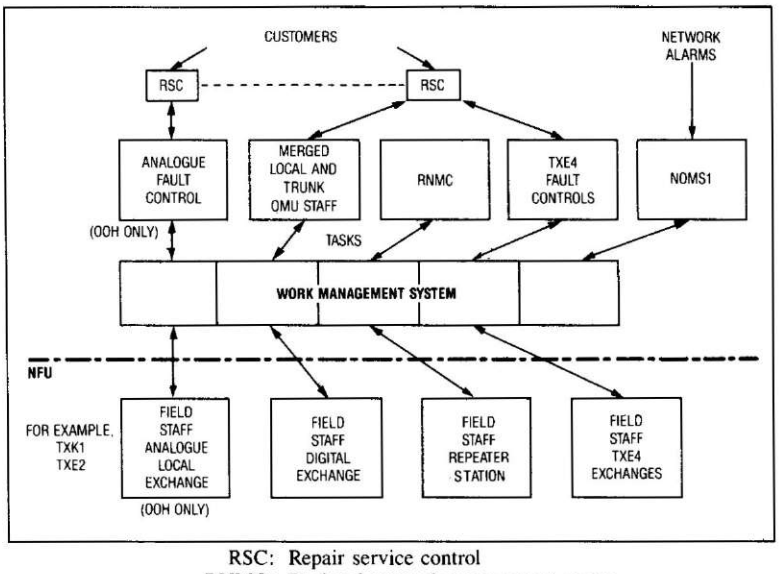
By early 1992, a dedicated network of M1779 terminals should be available to provide NFU access to all tools in the NACC. This will consist of an INTERNET local area network (LAN) bridged to the NOU INTERNET LAN with terminals provided at all network equipment locations. Figure 7 illustrates the communication network planned to be in place by the end of 1991.

In the longer term, mobile field terminals may be introduced to enable the field force to interrogate databases from unstaffed network locations, including customer premises and street furniture.

CONCLUSIONS

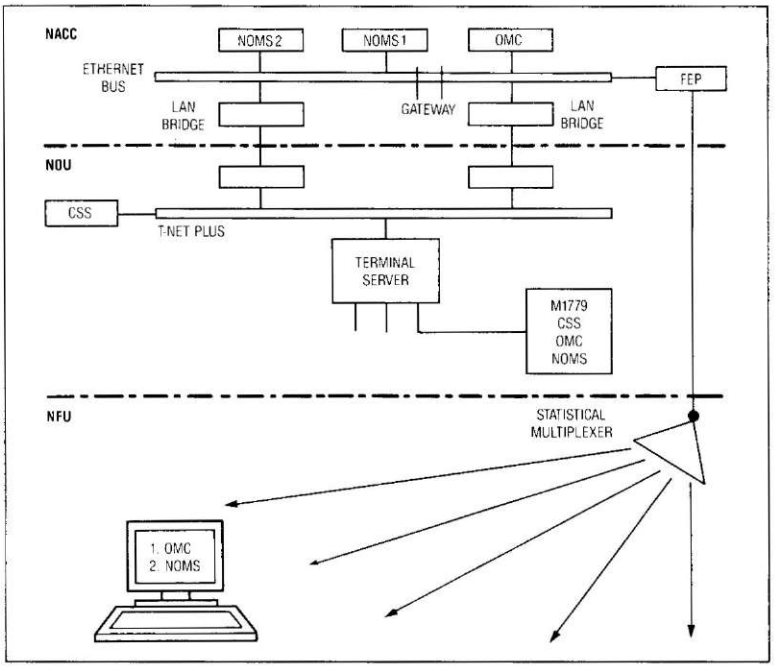
NAIP will introduce significant changes into the methods currently used to administer the network. This article has described how the NFU fits into the overall NAIP structure and how the relative roles of the NOU and NFU will bring about overall improvements to quality of service and reduction in costs by the rapid deployment of a mobile, multi-skilled field force operating under the direction of an automated work management system.

This article was written before the Project Sovereign reorganisation structure for Worldwide Networks was announced and these organisation changes may impact on some of the principles outlined in this article.



RSC: Repair service control
RNMC: Regional network management centre
OMU: Operations and maintenance unit
NOMS: Network operations management system
OOH: Out of hours

Figure 5—NOU–NFU task handling



FEP: Front-end processor

Figure 6—NOU–NFU communications, 1990

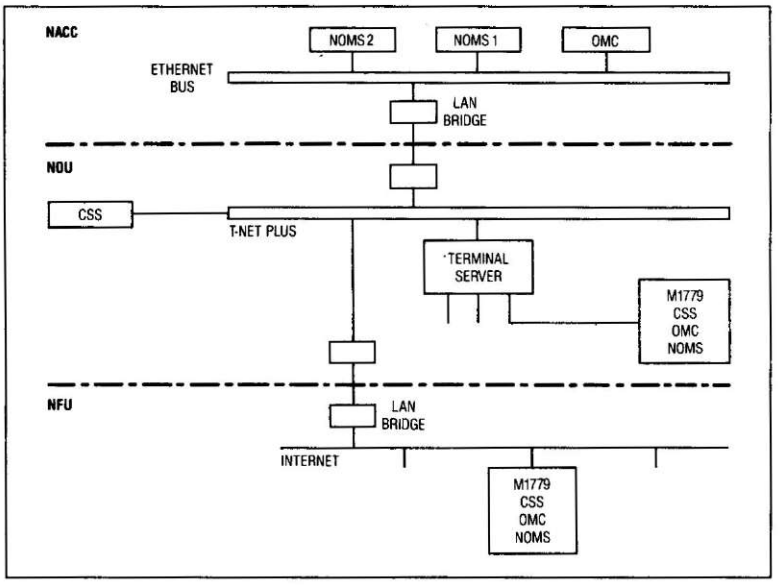


Figure 7 NOU–NFU communications, 1991

ACKNOWLEDGEMENTS

The authors would like to thank the various District, Region and HQ members of the NAIP NFU Field Working Group whose experience and imagination has made a significant contribution to the views expressed in this article.

Biographies

Peter Blake joined the then Post Office in 1956 as a Youth-in-Training in the South West Area of London. After national service with the Royal Signals, he joined the Circuit Laboratory in Telecommunications Headquarters. He passed the Limited Competition for Assistant Executive Engineer in 1963 and worked in the Development Department on a number of projects including development of routiners for the transit network and design of MOS LSI circuits. He transferred to the Operational Planning Department in 1975 and was involved with the project control for the introduction of TXE4 into the network. He was appointed Head of Group in the System X Launch Department in 1979 with responsibility for the introduction of the early System X exchanges into the network. He joined National Networks on promotion to Level 4 in 1983 as Switching and Transmission Works Manager and this was followed by his current appointment as Trunk Network Regional Manager for South West in 1988.

Phil Lamb obtained a B.Sc. in Communication Engineering from Plymouth Polytechnic in 1975. Prior to joining the Post Office in 1978, he worked as an electro-optical circuit designer. After two years on private wideband planning in Telecommunications Headquarters, he moved to Madley Earth Station as maintenance manager in 1980 before joining STC Defence Systems in 1984 where he worked on communication and military laser development. He returned to the Bristol office of BT Network Planning and Works in 1987 and moved to the NAIP support group the following year. He is a member of the IEE and a European Engineer.

The Practical Issues of Network Operations Unit Piloting

R. CULSHAW†

The piloting of projects represents a vital stage in their life cycle, as it is the transition from what is essentially the theoretical to the practical, with all the concomitant teething problems. For a programme the size of the Network Administration Implementation Programme (NAIP), not only the piloting but also the infrastructure required to support it is of considerable complexity. This article describes the setting up of the first pilot network operations unit (NOU), a key element in the evolving British Telecom network administration structure, and the attendant problems, lessons and impact on staff of establishing functions within it.

INTRODUCTION

With the strategic approval of the Network Administration Task Force (NATF) report by the British Telecom UK Main Board in September 1987, a viable approach was sought to pilot the new network administration recommendations it contained. It was recognised that, to achieve the benefits predicted and to test the proposals realistically, a catchment area similar in size to that recommended for network operations units (NOUs), the key building block for the new administration structure, would be required.

The merger of the previous North and West Midlands, and Central Midlands Districts in early 1988 presented the opportunity of a District catchment area approaching that required to validate these proposals. Therefore in April 1988, the newly formed West Midlands District was approached with a view to creating a pilot NOU site. With the selection of accommodation at Walsall, some nine miles from the centre of Birmingham, and the transfer of both Regional and District digital maintenance controls to this site, the first NOU was declared open in October 1988.

In the months that followed, more activities were moved to Walsall, and, as a result of considerable effort and teamwork, the embryo NOU was transformed from being a collection of people and functions drawn from two Districts and a Trunk Region into an integrated, professional and effective network control centre. It was not without its problems and the task is far from finished; however, the progress made over the last 18 months has been excellent.

This article describes, in outline, the sequence of events, the learning process and successes of the pilot implementation project. While those establishing future NOUs will have the advantage of more detailed guidance, they will still need to address the issues faced during the establishment of Walsall and the lessons learnt should stand them in good stead.

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DESIGN STAGE

Inevitably, the first major decision to be made in the creation of the pilot site was the selection of suitable accommodation. At the outset, there was little or no experience on what space would be required and how it should be tailored for operational needs. It was anticipated that somewhere in the region of 3000 m^2 would ultimately be needed for a fully operational NOU and so, in the short timescale dictated, the number of potential sites was fairly limited. Fortunately, the site at Walsall offered 1500 m^2 at an early date with the addition of a further 1500 m^2 once the group switching centre (GSC) located in the building had been closed and its associated equipment recovered.

Once Walsall was confirmed as the selected site, the next stage was to communicate the impending major change in operations to all staff involved. This was the commencement of the important work concerned with the vital issues associated with people and the management of change. Team briefs, workshops, and written communications were all employed, coupled with union consultation, as part of an ongoing commitment to build in this area.

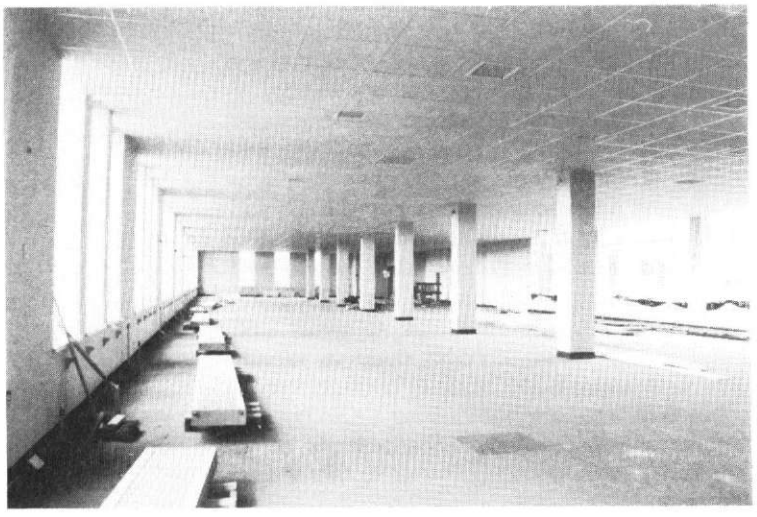
External view of Walsall NOU during refurbishment

Refurbishment under way

With the communications to people under way, attention was turned to the physical realisation of the NOU. It soon became apparent that this in itself was a vast and complex subject ranging from the total communications needs for voice and data through to the more mundane, but equally important, items such as welfare facilities and furniture requirements. For every issue that was anticipated at this stage, at least two more were to emerge as the project continued; however, effort expended in basic planning is rarely wasted as it invariably leads to a significant reduction in problems during later stages.

The next question to be addressed was that of the basic layout of the floor space. The functions that were to be moved into the NOU were detailed in the NATF recommendations but the order in which these moves were executed and the siting of functions relative to one another was the subject of debate with the national programme teams. Some work on defining task volumes and types of interfaces assisted, and potential costs and benefits indicated that the maintenance or operational support centre (OSC) functions, as they are known in the Network Administration Implementation Programme (NAIP), should have priority. In addition, it was seen that certain functions, such as circuit-provision control and capacity management, had a possible close affinity which would merit their collocation with the OSC.

False floor and ventilated ceiling fitted



After firm decisions on the floor layout came the detailed planning of the building works. As an existing operational unit, the building already contained a considerable number of people in addition to the GSC equipment. Some of these people had to be relocated and for those that remained the modifications required were planned in such a way as to minimise disturbance. However, considering the scale of change, it was inevitable that some disruption would occur and the forbearance of those people affected over the last 18 months is acknowledged.

IMPLEMENTATION

To realise a rapid operational presence in the NOU, it had been seen early on that, in common with many major projects, the construction of the unit would need to be executed in phases. Thus, with the planning completed, the initial phase of construction was started and, despite many revisions to the original plans brought about by network modernisation delays, budget difficulties and fundamental re-thinks, the accommodation refurbishment progressed within overall timescales to its completion in September 1988.

As previously mentioned, it had been decided that the OSC function would be the first to be implemented and so the initial thrust was to relocate the regional network management centre (RNMC) and the trunk and local operations and maintenance units (OMUs).

Once these functions had been moved into the NOU it soon became apparent that, owing to their differing origins, there was a disparate number of practices and procedures in use, designed to achieve the same aims. This was not only true between trunk and local, as might be expected, but also between various District units.

As it is a major aim of the NAIP to achieve common practice in order to provide network customers with a single interface along with the benefits of unified support systems, training and documentation, considerable effort was made to ensure that this was successfully achieved.

The move from a disparate range of working practices towards a common way of operating has been both the the hardest and the most beneficial task undertaken during the lifetime of the pilot. Team discussions; guidance from, and involvement in, the national working parties; strong links and lively discussions with fellow 'piloters' in the North West have all contributed to the evolution of common procedures, interfaces and an enhanced understanding of the requirements of new support systems being developed for the programme.

Progressively, further functions have been added to the NOU, including a TXE4 control,

the District digital support group, Regional transmission support group, system access security officer function, performance management and so on. As each function was added a new dimension to the overall working of the NOU had to be considered with new people to be integrated, new ideas to be assimilated and new common procedures to be established.

In August 1989, the second phase of the accommodation was available and the District and trunk internal works controls were also relocated to Walsall, initiating the evolution of an integrated internal works function.

Although not part of the platform, a dedicated duty was also set up to act as a unified control point for other licensed operator (OLO) operational problems, and the District and Regional data managers were also moved in. This last move has brought many benefits; in particular, where data can be the cause or solution to an operational network problem.

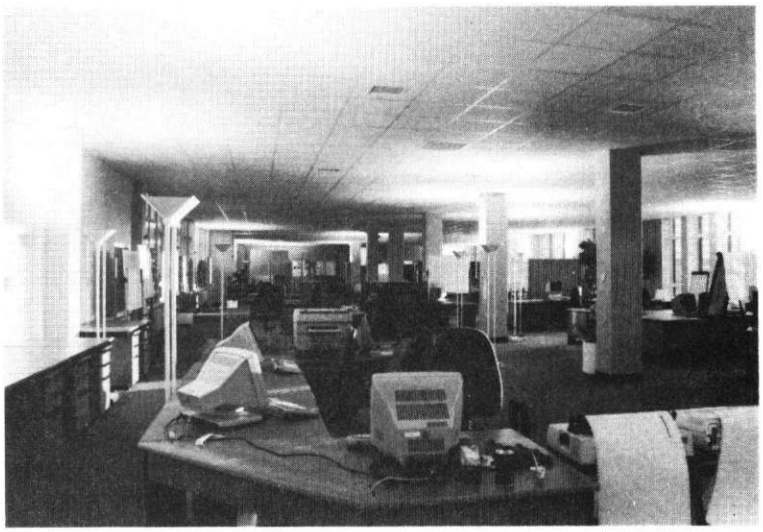
BENEFITS

It has taken some time to bed down all the changes. However, even during their height, performance on cost and quality continued to improve. It has been very difficult to distinguish all savings and quality improvements that have come from the NOU alone, particularly during a period when the network infrastructure has changed so much, but it is obvious that there have been many improvements that would have been difficult or impossible to achieve without the NOU environment.

Over recent months, the NOU has started to show its true potential for service improvement with all mainstream quality measures showing positive changes. The improvement in equipment down time has been particularly significant in changing at a faster rate than average, thus validating the NATF view that closer co-ordination and better visibility of network status would bring such gains.

It has been a difficult culture change to begin to see the NOU as a true control centre for the network, as traditional controls have in fact been little more than postboxes. At the same time as gaining control, a balance must be struck such that operational staff in the field recognise that they still have the opportunity to exercise initiative. This area still requires more work, but progress has been made.

There is no doubt that the NOU has provided a catalyst for ideas as, in forming standard practice, new ideas have to be generated and captured. There is still a great deal of opportunity as more functions are added and existing ones developed. It is in this area that the people issues associated with the 'management of change' in any large project, can be best addressed. The greater the involvement, the better the ownership and the ultimate success of the changes.



Completed operational support centre (OSC) area

The NOU has also enabled much better visibility of the performance of the network as there is now a single and definitive source of information for anyone outside the network organisation to seek guidance 24 hours a day. Customer-facing staff, senior managers, public relations and many other groups are finding the advantage of a single point of contact for resolution of network problems invaluable.

Selecting and implementing common/standard practices has not been an easy task and it is not yet complete. However, the work done to date does show the benefits from standard interfaces, the ability to collect management statistics on a common basis, the ease of introducing updates and changes and the advantages of a common reference point for all those involved in the process.

The pilot sites have a unique position in that they have been able to play a major role in the definition of some of the standard practices. There has been much enthusiasm from the people involved and a great deal of innovative work done.

FUTURE

The impending restructuring of British Telecom to provide network- and customer-facing divisions will enable not only practices to become standard but also provide the opportunity to form corresponding organisational structures. The customer-facing part of the business will rightly demand simple and effective interfaces to network operations and services—NOUs will be a significant factor in achieving them.

There are still many benefits to be achieved by consolidating functions into the NOU environment including such things as power and building engineering services controls, circuit provision controls and capacity management in addition to expanding the existing TXE4 control to take advantage of the enhancements being provided in this switching system to take it into the next century.

Specifically at Walsall, the next challenge will be the relocation of the OMUs from East Midlands District thus ensuring that the customers they serve are afforded the benefits of British Telecom's most advanced network administration practices. There is still much to be done, but also much to be won.

CONCLUSIONS

The major lesson learnt in this project has been about people and the way they work. It is a relatively straightforward task to move controls and equipment, but the trick is to harness the energy, enthusiasm and creativity of the people involved to ensure that the new administration is better than the old. Customers need to see positive improvements and it is people who ultimately make those improvements. The Walsall pilot has done some things well and others not so well, but we have learned from mistakes and moved on.

Standard practice is the key. Involvement in the formulation of standard practice by those required to implement it is essential, as without staff commitment and effective practice the NOU cannot achieve its full potential.

Once common practice has been identified, it must be documented. This does not need to be a complex exercise, but without a written definition of a practice, it will never be carried out by people in a standard manner. It will tend to change as the people carrying it out also change. Therefore, it is imperative that once a process, however small, has been decided, it is recorded.

As pilot site manager, the author is convinced that the NATF concepts have been validated. The NOU and its associated practices, process documentation and support systems are the only way that the new network organisation within British Telecom will be able to deliver the service that customers require. The benefits are there to be had; indeed, there are undoubtedly more than anyone can imagine.

As additional NOUs are opened and more functions added, the level of ideas and improvements will also grow, ensuring that the pioneering work at the pilot sites is built on and that the service provided by the network of the 1990s is second to none.

Biography

Roger Culshaw joined the then British Post Office in 1972 after studying electrical and electronic engineering at Loughborough University. His early career was spent in a Headquarters-based planning unit and subsequently at BT's training college at Stone teaching the same subject. From there, he moved to the Stoke Telephone Area as Area Engineer and then became District Engineer for the North and West Midlands District. He is currently District Engineer for West Midlands District, a post he has held since the creation of the District from the merger of the North and West Midlands and Central Midlands Districts.

Realising British Telecom's Network Administration Policy in London

J. HOWE, P. NEWMAN, and A. KHAN†

This article explains the need for the Network Administration Implementation Programme (NAIP) processes to be validated against the London environment and gives an overview of the project management framework used within London to manage NAIP.

INTRODUCTION

London Network Operations (LNO) has invested many millions of pounds in modernising the London network. This investment has focused on replacing network elements with modern System X and AXE10 switches, fibre transmission bearers and higher-order digital multiplexers.

This investment, which has centred on the crucial business communities of the capital city, has paid off handsomely in the very high quality of service being offered to network customers.

The Network Administration Implementation Programme (NAIP) is seen by LNO as being one of the major programmes by which this quality of service can be maintained, and probably improved, at the low-cost base which is available with modern technology.

The principles of centralised monitoring and control, remote maintenance where possible, and direction of the field units to perform physical work are fundamental in achieving the required cost base.

It was initially perceived that the London NAIP project would be a straightforward implementation project, with the design of the various functions being delivered through national co-ordination. However, some of the process designs had not been fully validated against the London environment. Therefore, the London NAIP project resulted in not simply being an implementation project, but has been expanded to include this final validation of the design.

LNO is actively planning the implementation of NAIP in London with the first operations due to begin in late-1991. This article describes the project management framework used to manage this significant change in the method of operation.

OVERVIEW OF LONDON NETWORKS

LNO supplies public switched telephone network (PSTN) and private circuit (PC) services to some 5 million customers from the main distribution frame (MDF) to MDF, and to the network terminating equipment (NTE) where there is fibre delivery in the local loop.

Key statistics are given in Tables 1, 2 and 3.

TABLE 1
London Network—Local Exchanges

System	Lines	Processors	RCUs
System X	2M	91	156
AXE10	500K	22	59
TXE4(E)	1·6M	116	
Analogue	500K		

RCUs: Remote concentrator units

TABLE 2
London Network—Trunk and Junction Exchanges

System	Processors	Traffic	Routes
System X	22	360 000 erlangs	4688

TABLE 3
London Network—Transmission Paths

System	Number
2 Mbit/s paths	43000
8 Mbit/s paths	1971
34 Mbit/s paths	1486
140 Mbit/s paths	711
565 Mbit/s paths	21

SIMPLIFYING THE TASK

NAIP is a very large project which, in London, impacts upon the work of large numbers of staff. In order to ensure success, steps were taken to simplify the task:

TXE4 Co-ordinated Management Approach

Four co-ordinated management approach (CMA) centres for TXE4 exchanges are being established, one each at Baynard House,

† London Network Operations, British Telecom UK

Greenford, Bromley and Chingford. These centres will also deal with alarms from analogue exchanges and some transmission and power alarms. These centres will be established separately, developed, and then migrated to the network operations unit (NOU) when it proves economic to do so.

Location of NOU

In theory, the remote control of the network can be done from a NOU located anywhere. Since the cost of operating in London is higher than elsewhere in the country, because of property values and higher pay rates through London weighting, it is an obvious attraction to site the London NOU out of London. However, a site in Central London has been adopted for a number of reasons:

(*a*) NAIP is a project which will fundamentally change the way in which staff work. The adoption of a site in Central London means that staff will not simultaneously have to deal with the change in work practices as well as a change in location.

(*b*) The introduction of NAIP is at a time when the network would still be going through the 'final' stages of network modernisation. A degree of local knowledge is therefore imperative/inevitable to ensure the efficient operation of the network.

The attraction of an out-of-London operation remains. Therefore, a feasibility project has been established to examine the possibility of siting the NOU out of London in 5–8 years time. This will enable NAIP to be implemented in London, with a minimum of 'people issues', while enabling the advantages of relocation to be investigated and pursued.

Size of London NOUs

As can be seen from the overview of the London network, London already has over 4 million digital and enhanced analogue lines and 22 trunk exchanges carrying 360 000 erlangs of traffic. To control this volume requires the equivalent of three provincial NOUs. Initially, therefore, three NOUs were to be established for London. However, a simplified implementation of NAIP is being pursued and only one NOU is planned.

The realisation of one NOU to control London is dependent upon sound design. Part of the design process will be to establish documented processes and procedures that will enable these three units to become one. When completed, an NOU will have been built with the capacity to monitor and control over 20% of the UK network.

NOU DESIGN

Design Process

The complexity of LNO's administration structure is such that, if NAIP in London is to be designed to its optimum cost and functionality, a rigorous design process is required. This will:

(*a*) prevent the importation of current practices unless they are the best available;

(*b*) ensure that costs are maintained as low as possible by eliminating unnecessary interfaces, procedures, tools and support systems; and

(*c*) ensure that the cost profile of each NOU function is documented and understood.

Such a design process is under way using sound project management techniques to develop a standard design template for NOUs. The client requirements definition (CRD) for this project has been written which states that 'The purpose of this project is to produce sufficient structured documentation so that NOUs can be implemented in the field to a standard design base'.

Rigorous attention to design will also ensure that the upgrade path of the administrative system can be managed incrementally and smoothly through successive NOU builds.

The technique of *functional breakdown*, by aligning the functional specification in the London NAIP project requirements definition (PRD) with the Strategic Systems Plan (SSP) Level 4 processes, then breaking them down to an appropriate degree of detail, followed by a physical re-composition, will be employed.

The output of the project will be in two parts:

(*a*) A logical functional breakdown of the work and information flows in and between functional groupings. These processes will be linked to SSP processes. The processes will be appropriately marked with volume and timing information.

(*b*) A physical set of design rules derived from the functional breakdown which contains:

(*i*) the training and grading requirements of the job;

(*ii*) standard handling times for operations;

(*iii*) the tools which support the job (computers, software, screens, documentation, communications links (voice and data); and

(*iv*) the numbers of people for each job type.

The work will embrace all processes inside the NOU and all external interfaces (for example, front office, other NOUs, circuit provision controls, data management and its interface to the network field unit (NFU) at platform build).

NOU Overview

The platform-build NOU consists of seven major processes:

(*a*) enquiry point,
(*b*) digital exchange operations,
(*c*) workforce management,

(*d*) transmission operations,
(*e*) NOU management,
(*f*) network operations administration, and
(*g*) power operations.

In order to produce a full NOU design, each of the processes identified above will be decomposed into the lowest possible function/process. Any common or duplicate functions/processes will then be unified and integrated into a single function. This will then be followed by an 'integration' phase which will ensure that each task or operation fits into an efficient physical realisation that defines all operations within the NOU, their interfaces, volumes, documentation, support systems, tools, space requirements, job descriptions and training requirements. This will form the NOU design.

NOU IMPLEMENTATION

The London NAIP project is built around the principles stated in the BTUK project management handbook. The key documents in this are summarised below. The objective of this project is to implement the NOU design in the most cost-effective manner thus reducing the cost of administering the London network.

NAIP involves understanding current work practices, designing the new process and procedures, implementing them and testing the result to ensure that they are working and achieving the desired results in terms of time, cost and quality. This affects people, and a major part of NAIP is about people. NAIP is not fundamentally about new accommodation and relocation. It is about people and the way they work.

To ensure success, it is therefore necessary that the implementation of NAIP is defined, designed, planned and tested and that this is managed by using sound project management principles. The vehicles used in London to do this are as follows:

Client Requirements Definition (CRD)

This clearly states the LNO Board requirements in terms of time, cost, quality, specification and critical success factors. The business, project objectives and critical success factors for the London CRD are as follows:

Business Objectives

LNO's key business objective is expressed in the mission statement: 'To plan, install and maintain a high-quality, flexible and cost-effective network in London that provides a range of network-based services that fully meet the customer requirement and expectation'.

The London NAIP project is in direct support of the mission statement and the 1995 vision by

(*a*) reducing the cost of operating the network,
(*b*) enabling better control and management of the network, and
(*c*) improving the quality of service.

Project Objectives

The project objective is to implement NAIP in London. This will require the implementation of a series of processes, procedures and support systems, designed and developed within NAIP. This objective is targeted at LNO's vision of a more efficient organisational unit, specifically through reductions in the unit cost of administering the network in London. As the NAIP Platform build is the only authorised build of NAIP, the functional scope is defined by the Platform stage of NAIP.

Critical Success Factors

The project will be deemed to have met its objectives if the following critical success factors have been met:

(*a*) the NOU manager meets the response times demanded by the end customer and the mean time to repair (MTTR) of the equipment;
(*b*) the costs of the operation match the agreed standard in terms of manpower per exchange connection (or erlang) with all the work being performed at the appropriate grade (managers, engineering and technical, clerical) supported by appropriate computing tools;
(*c*) the NOU manager is proactive in the prevention of faults being perceived by customers (by regular routing checks, analysis of transients, measurement and analysis centres (MACs), Telcare, charging-accuracy checks, exchange fault output etc.);
(*d*) the NOU manager makes most effective use of the available network and plant capacity;
(*e*) a quality organisation with all processes and procedures fully documented and regularly audited to ensure conformance, with, as far as practical, these processes being nationally adopted processes, with any departure from national processes being signed off by Headquarters;
(*f*) a team in which staff have job satisfaction; and
(*g*) the London NOU will have all the functionality required of the NAIP Platform build.

Project Requirement Definition (PRD)

The PRD, which is the practical response to the CRD, defines what LNO is actually going to do in terms of functional specification, test specifications, time-scales, deliverables, project objectives and project scope. The PRD also includes outline information on risks and contingency plans.

The London NOU Definition Document

The LNO Board laid down a basic set of policies and principles that defined an NOU. This document, the LNO NOU definition document, contains:

(*a*) the functionality of the NOU; that is, what goes into the NOU at platform build;

(*b*) its work systems; for example, functionalised input of faults and patch oriented allocation to the network field unit (NFU);

(*c*) operational, environmental and personnel policy decisions; and

(*d*) management organisation guidelines.

Project File

The *project file* is the main reference document for communicating details about the project and how it is to be implemented to everyone involved in the project. The London project file is in two volumes and its main sections are:

VOLUME 1

0 Index and File Control

1 Client Requirement Definition (CRD)

2 Project Requirement Definition (PRD) and London NOU Definition Document

3 Project Strategy

This includes organisation, economics, priorities.

4 Project Plans

These include summary plans, master plans and cost plans.

5 Project Procedures.

These include issues management, change control, project co-ordination, progress monitoring, document tracking and procurement.

6 Standards

VOLUME 2

This contains the project work breakdown structure and work packages.

Project Plan

A project plan is being produced for the London NAIP project based round seven project phases:

Inception
Feasibility
Definition
Development
Installation
Migration
Acceptance

Within each phase, the necessary work packages are represented by a precedence network of activities. The project plan is developed on a phase-by-phase basis with only the current and following phase being fully defined at any one point in time. The definition phase of the project life cycle ends with financial authorisation of the project.

Work Breakdown Structure

A *work breakdown structure* defines the scope of a project. It defines in a structured way the deliverables to be produced and enables each work element to be related to each other by using a family tree. From the top-level major work areas, the work breakdown structure is progressively broken down until all the necessary work has been defined.

The LNO NAIP project work breakdown structure consists of the following areas of work:

(*a*) *Strategy*

To determine the strategy, including the identification of costs and benefits, for adoption of NAIP as a major initiative by LNO. This initiative is a key element in the drive to improve the quality and reduce the operating costs of the core (PSTN) network.

(*b*) *People Issues*

To inform staff, by effective employee communications, on the progress of the LNO NAIP project and how it will affect them and their jobs.

To establish and maintain a forum for staff association/union consultation.

To develop and define NOU organisation and job descriptions.

To define, develop and implement the NOU staff training programme.

To manage the NOU staff selection and transfer.

To prepare and implement redeployment plans for residual staff.

(*c*) *Accommodation*

To specify, design and deliver accommodation including office furniture and equipment for the NOU to agreed NAIP standards. The accommodation should meet the criteria specified in the LNO NAIP accommodation specification of requirements.

As part of the process for obtaining financial authority for NAIP expenditure, estimates of accommodation refurbishment costs are required.

(*d*) *NOU Design*

This work package has been established as a separate project and is described earlier in this article.

(*e*) *Communications and Computing*

To provide voice, data communications network, LAN and NOU LAN communications and computing, terminal and office automation facilities within the NOU, that will enable the agreed administration of London networks, as identified by the functional breakdown and recomposition.

To provide cost estimates of outline and detailed communications and computing designs. This should include providing a flexible, secure and resilient network with contingency for fallback. It should interface with existing and new support systems and tools.

To specify and carry out commissioning and acceptance tests to ensure voice, LAN and non-LAN communications and computing, office automation and data communications networks meet the requirements specified in the communications and computing schedule of network requirements. Where appropriate, national NAIP standards should be used.

To establish ongoing site support and necessary documentation, training etc. for system hand-over.

(*f*) *Testing*

To apply operation and acceptance tests to the various functions, systems and procedures at the NOU to ensure they meet LNO's quality requirements. This process should include the following:

(*i*) specify and complete operational tests on systems and procedures;
(*ii*) specify and complete acceptance tests on systems and procedures;
(*iii*) specify integration testing;
(*iv*) acceptance testing on any modifications implemented; and
(*v*) acceptance tests to show that the project has delivered functions and processes which meet the critical success factors as laid down in the LNO NAIP project requirement definition (PRD).

(*g*) *Migration*

To plan and manage the migration of network functions, alarms and people from their existing locations to the NOU as appropriate. This migration will be in accordance with the adopted NOU design.

Cost Control

It is essential to ensure that the project spend is monitored and controlled and that the spend is recorded against work packages. The project office will therefore track actual spend and percentage work complete for work packages.

The recording of actual spend and percentage work complete are, by themselves, insufficient to provide adequate financial control of the project. The project office will therefore calculate the following:

Earned Value

The *earned value* (EV) is the value of the work actually performed according to the initial cost estimate for that work. It does not indicate whether targets for cost or performance are being met, but is simply a measure of the value of the work. It is calculated by using the following formula:

Earned value or budget cost of work performed

$$= \textit{cost estimate at completion} \times \textit{\% work actually done.}$$

Scheduled Performance Index

The *scheduled performance index* (SPI) is a measure of the work performed. It enables the easy identification of whether the project is on, ahead or behind schedule. If the SPI is greater than unity, the project is ahead of schedule; if less than unity, the project is behind schedule. It is calculated using the following formula:

Scheduled performance index

$$= \frac{\textit{earned value}}{\textit{cost estimate to date}}$$

Cost Performance Index

The *cost performance index* (CPI) is a measure of the cost of the work performed. It enables the easy identification of whether the project is on, ahead or behind its cost schedule. If the CPI is greater than unity, the project is under budget; if less than unity, the project is over budget for the amount of work done. It is calculated by using the following formula:

Cost performance index

$$= \frac{\textit{earned value}}{\textit{actual spend to date or actual cost of work performed}}$$

Benefit Tracking

Having established that the NOU would be in Central London, it was a frustrating routine task to find a suitable site. However, once one had been found, the costs of refurbishing the building were simple to identify. It was not so easy to attribute the savings due to this investment and not already claimed under another programme.

Other programmes which were, and are, contributing to more cost-effective administration are:

(*a*) network modernisation with the consequential elimination of the analogue/digital interface in the network;
(*b*) maintenance staff themselves being more proficient through experience;
(*c*) reliability growth of the TXE4, System X and AXE10 switching systems;
(*d*) the 10-node plan which leads to a simpler more robust network topology for London;
(*e*) improved line test systems and more experienced staff in the repair service centres;
(*f*) the introduction of Customer Service System (CSS); and

(*g*) direct management action.

Quality Control

In order to ensure that the London NAIP project achieves the desired quality standards, a quality assurance manager is to be appointed whose role will be to ensure that the project achieves its critical success factors and specifically for the following:

(*a*) Establish a quality system for the London NAIP project and co-ordinate all quality matters. This will entail establishing roles and responsibilities that ensure the quality plan is met. Its detailed test schedules and design reviews are implemented progressively throughout the life cycle of the project.

(*b*) Create a quality plan by expanding the critical success factors into detailed test schedules to ensure that the project achieves its objectives, that project deliverables are fully specified, with sufficient design reviews to ensure delivery at the agreed cost with no reworking or contract variations.

(*c*) Establish a training programme to ensure that all project staff understand and can apply the techniques and principles of quality management.

(*d*) Investigate and report to the project manager or project owner any departures from the required quality standards.

CONCLUSION

NAIP is a complex national programme. It is there to design and implement a network administration system which is as technically complex as the switching and transmission systems being administered.

Further, just as the switching systems will be progressively enhanced and added to, so the administrative system can be expected to be enhanced as manual processes are automated.

However, it is not as straightforward as in the switch where a major design issue is in the software/hardware balance. The administrative system must cope with a changing computer/human balance.

This human angle demands that the design of the administrative system is very carefully and thoroughly developed, tested and proved, and that the design is implemented in its physical form with attention to detail and meets management's requirements.

For this reason, the London NAIP project is founded on the triple basis of:

- detailed design of the work flow,
- excellent planning and project management, and
- careful attention to the people issues.

Biographies

Jim Howe joined the then British Post Office (BPO) as an apprentice in Glasgow Telephone Area in 1959. He moved to Telecommunications Headquarters Development in 1969 where he was employed over the next 18 years in various aspects of digital switch development and support. He moved to London Network Operations in 1988, where he is currently District Engineer (Network Support).

Paul Newman joined the then BPO as an apprentice in London South West Area in 1972. In 1980, he moved to the London Telecommunications Region Headquarters on strategic planning where he worked on economic routing criteria. He subsequently moved to West End District where he was employed on various duties, covering all aspects of switching and frame maintenance. He established and managed a System X maintenance organisation for the district and is currently the project manager for London NOU implementation.

Aman Khan is the NOU design project manager. He joined the then BPO in 1980 and worked on resource control and sub-system/system design aspects of the System X development programme. In 1984, he moved to the British Telecom International Technical Strategy Unit. In 1989, he was appointed the project office manager for the London code change before taking up his present role in June 1990. He graduated in Electronic and Electrical Engineering, and is a Chartered Engineer and a Member of the IEE.

Preparation for National Roll-Out of New Network Administration Developments

K. RICHARDSON†, and R. J. SILK*

This article discusses the work required to be carried out prior to actually implementing the Network Administration Implementation Programme Platform, for example, obtaining authority and assembling teams, in order to ensure a smooth and successful implementation.

INTRODUCTION

The operational scope of the Network Administration Implementation Programme (NAIP) and its first phase, the *Platform*, is described elsewhere in this issue of the *Journal*[1], but it can also be considered from management and human perspectives.

In the management view, it is about investing resources (manpower and financial) in order to achieve efficiency and customer-perceived quality improvements. As is normal with any major investment decision, a business case needs to be made in order to ensure that the investment is valid and can be given an appropriate priority—there are many competing demands for resources.

From the human-relations viewpoint, the project teams need to be selected and their commitment engaged to make it all happen and achieve success.

THE BASE CASE

Preparing for roll-out starts with a successful business case; that is, senior management endorsement that the objectives are worthwhile and the investment to meet them is justified.

The first step in preparing a business case is to establish the base line position; that is, a 'where are we now' statement. This is known as the *base case*. Without this information, it is impossible to prepare the business case properly in theory and track achievement in practice.

This base case must cover both operational and financial factors relevant for the project concerned. NAIP Platform examples are:

(*a*) the number of centralised surveillance and control centres; for example, operations and maintenance units;

(*b*) the numbers of 24 hour rotas; and

(*c*) the manpower deployment in each major sector of activity; for example, trunk switch maintenance, local transmission maintenance, performance monitoring.

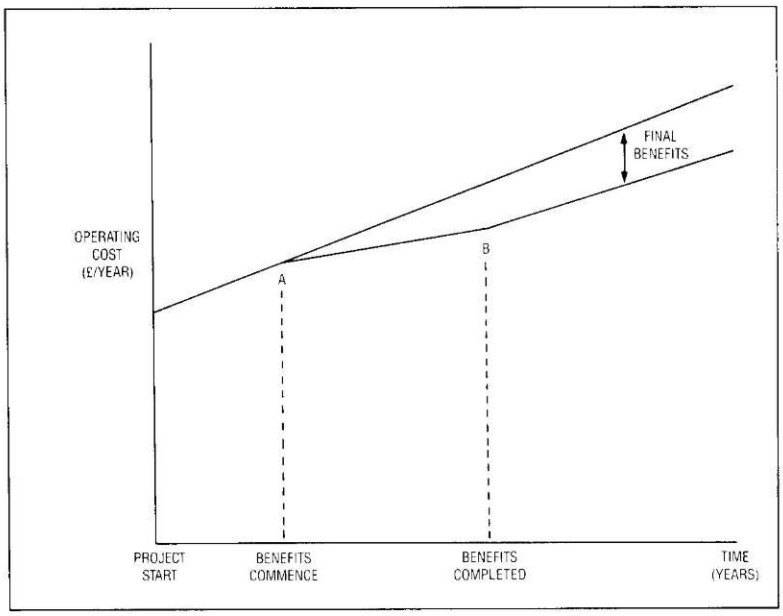
Activities such as the frequency of attending training courses and updates of documentation also form a part of the base, as they represent the gross ongoing activities which may be utilised to reduce the nett work or expenditure needed for the project.

The base information is, of course, changing in relation to current planned activities and so not only must it be captured for a specific start year but it must also include projections for subsequent years. The projections will be based on changes flowing from other planned projects; for example, local switch modernisation, and improvements of efficiency arising from improved plant reliability.

Figure 1 shows diagrammatically a simplified base case. The top line shows the current projected operating costs; that is, increasing with factors such as growth of network size and usage. The lower line is the projected effect as a result of the project and shows a reduction in the rate of increase starting from when the project's benefits commence (labelled A) followed by a return to the same rate of increase but from a lower absolute point (labelled B). The vertical difference between the two lines is the benefit attributable to the project.

Preparation of the base has proved to be a difficult area to cover effectively. British Tele-

Figure 1
Base case



† Network Operations Support, British Telecom UK

* Trunk Network Operations East, British Telecom UK

com UK has so many projects being carried out in parallel that the effects of them collectively are hard to estimate accurately. A major initiative in this area has been the move to introduce Major Fixed Capital Programme (MFCP) managers in HQ to oversee all aspects of sectors of operations and to assess the impact and track achievement of projects in that sector. Sectors involved in the Platform include trunk switching, local switching, and core transmission. This control and oversight function should reduce the level of subjective judgements needed to generate the base.

However, a major exercise to scope the NAIP base, including the Platform, was carried out early in 1990. This involved consultation with all Districts and Regions for their plans for the next 2 years. This data was further projected using analysed historical trends and estimates from HQ experts on projects yet to reach the field. This exercise complemented and added value to the work done in 1989, based on HQ estimates of the base, for the Platform base case.

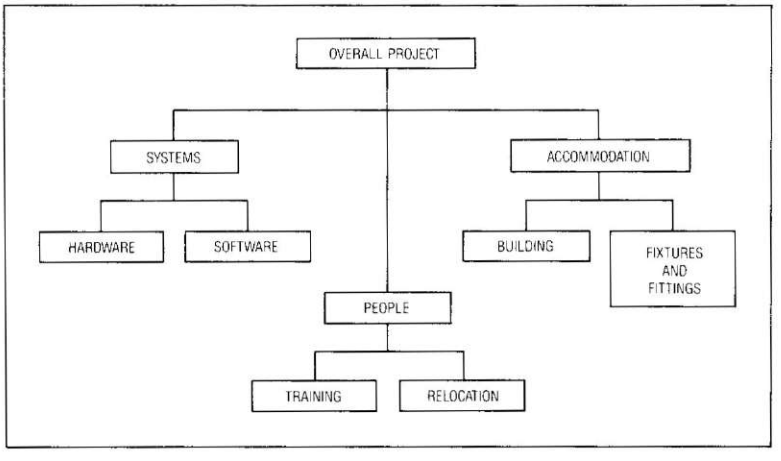
IMPLEMENTATION COSTS AND BENEFITS

Naturally the business case needs to state the proposed change clearly both in operational terms and financially for both costs and benefits. The base case is used to help quantification in these two areas.

The first stage is to clarify the scope and objectives; that is, define what the project is to achieve. This follows the project management approach discussed in another article in this issue of the *Journal*[2] and allows work to commence on assessing the potential costs and benefits resulting from the project.

On the costs side of the equation, this necessitates a full breakdown of the work required for successful completion. The detailed work is analysed into logically related packages of work and ownership assigned to the relevant expert (usually in HQ). These work packages can then be costed, typical costs for the Platform being for computer system development (for example, software) and deployment (for example, hardware), network operations unit (NOU) staff moves and accommodation. Figure 2 shows a simplified work package outline for the Platform.

Figure 2 Typical cost breakdown



On the benefits side, the users are consulted on what can be achieved in terms of efficiency and quality improvements; this is usually a dialogue to ensure that the proposed project is tuned to achieve maximum benefits. In order to provide a standard measure, these are then turned into financial assessments wherever possible. Attempting to evaluate the equivalents of apples against pears can lead to some interesting philosophical debates but rarely quick and effective decisions. Of course, for some benefits, it is not possible to quantify the benefits financially and they must remain as additional gains outside the main assessment. An example of the latter is expected improvements in speed of response of the network administration to changes in market forces.

To ensure that this process is carried out in a quality way, the assessments are tested with the relevant HQ experts to ensure that a common approach with common assumptions is being used across all projects (for example, switch modernisation, LinkLine product launch). Typical experts involved in the Platform came from financial, accommodation, marketing, and development disciplines in HQ as well as the MFCP managers already referred to.

THE MANAGEMENT PROCESS

To ensure that projects are successfuly completed, a management process is employed. The process needs to cover the several aspects mentioned in the article[2] on project management. A major activity in this context is that of tracking expenditure and achievement of benefits.

Cost tracking needs to be performed on a work-package basis; that is, the projected costs prepared for the business case are compared with the actual costs. The benefits tracking relies on the already established base case and monitoring changes to the projections, and the reasons for these changes. Both these areas need preparation work to be done before the main work of the project gets underway. This work ensures commonality of approach, for example, within the accounting system, for costs across all the people in the project responsible for tracking.

PREPARING THE FINAL BUSINESS CASE

Once the input data is available, it needs to be assembled into a cohesive whole. This process includes preparing supporting documentation and briefing papers for senior managers who may not understand the technical details but need to be able to assess the overall merit in business terms. However, most importantly, it includes optimisation of the case in line with business priorities.

The way in which a project is delivered can be varied to meet priorities. Once the input data is assembled, options can then be examined to

optimise implementation. Typical options here are to ensure low initial investment until the benefits are confirmed as achievable. This process may result in more complex and less elegant solutions being pursued but ones which are more closely tuned to actual business needs. An example for the Platform has been the need to exclude functional networks (that is, non-PSTN services such as packet switching and Telex), despite the clear vision of a singular network administration and potential advantages of common systems and procedures. This allows available resource to be concentrated on the area where the greatest and quickest benefit can be achieved.

For the Platform, the business case was approved by the BT Management Board in November 1989. This paved the way for a ramp up of resource deployment in HQ and for the component project cases to be prepared for authorisation.

Although another article[3] covers experience with the pilot scheme in more detail, it is worth commenting that the experience of the two early NOUs (Walsall and Manchester) has been invaluable in preparing for roll-out. In addition to the considerable contribution made on operational aspects, they have also assisted in the cost and benefit assessments essential for making a successful business case. In particular, the demonstrable achievement of the forecasted benefits in the pilot sites provides powerful support for the investment needed for full national roll-out.

ASSEMBLING TEAMS

Preparation of the business case of necessity involves a wide range of people many of whom will be involved with the actual implementation once the case is approved. This means the process itself aids the implementation stage by ensuring that key staff are already informed about the objectives and their own involvement. Perhaps most importantly, the people who will be involved in implementation have been able to contribute to the case and so have a personal commitment to making it happen.

Teams need to be assembled in both HQ and the field and, once this has been completed, they need to be kept informed about progress.

The HQ teams are assembled when a project has been defined and usually start from a core of HQ expertise and expanded to include field staff who have an interest and expertise in the subject area. It is vital that the output of the HQ projects not only satisfies the project objectives but is seen, by the staff who have to make the change happen, to be an advance on the previous operations.

Selection of the right balance of people is an important factor in ensuring later success. There is often a tendency to select people of like minds and similar backgrounds. In practice, this fails to give sufficient critical input and often results in changes of requirements when issues that have been masked are exposed late in the project life. Nevertheless, team building is also essential and the people selected must be able to work together—tight deadlines have done much to bring people together in the Platform.

LOCAL TEAMS

Introducing NAIP in general and the establishment of an NOU in particular is a complex task and many people throughout the catchment are involved. Strong links are necessary to ensure that local experts keep up to date with developments in head office and head office process managers are kept fully informed of field activities.

The local owner of NAIP is usually the senior network manager and is responsible for assembling the teams for implementation in the catchment. The first stage is to set up an implementation board. This group comprises other senior network managers within the catchment; that is, District Engineers, Regional Trunk Managers and NPW Zone Managers. Typical terms of reference for the group are:

(*a*) to establish and agree a roll-out plan for the catchment,

(*b*) to manage the implementation to the agreed plan, and

(*c*) to set up and manage the local implementation teams.

In some cases, there is an Executive Group of the District General Managers and Territory management to give direction and support to the Implementation Board.

The local Implementation Board's work is broken down into task areas where the people concerned with specific work areas can discuss and resolve issues on the detail necessary to move network administration forward. Figure 3 shows the organisation structure in a typical catchment area. Figures 4 and 5 give insights into the tasks being tackled at present.

It must be appreciated that the personnel working in these teams are, in the main, line managers at various grades who have a vested interest in the development of their own work

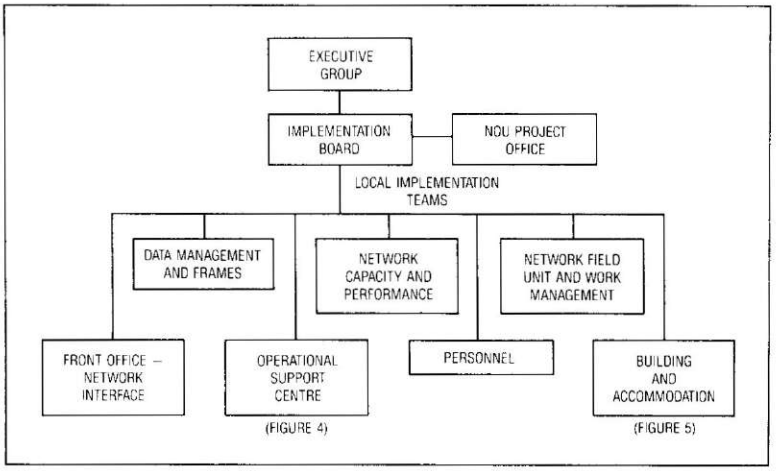
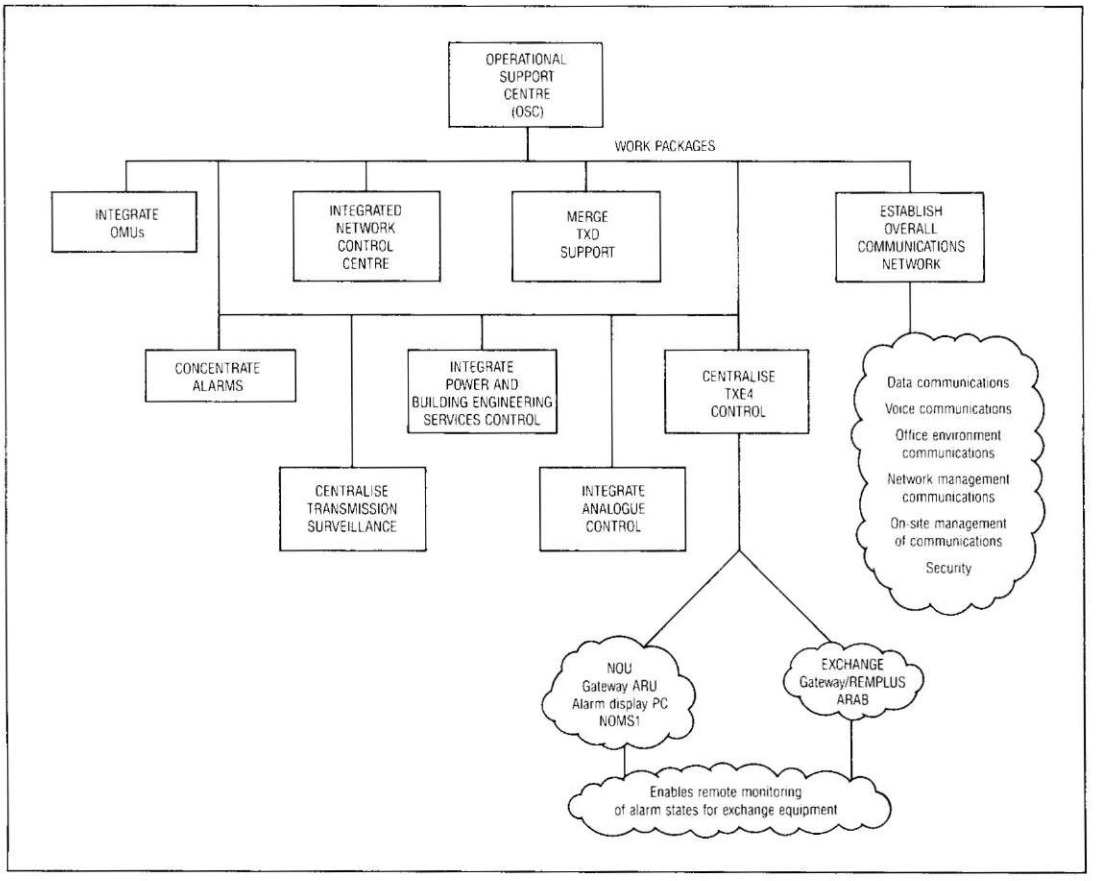


Figure 3 Typical NAIP catchment area organisation

Figure 4
Typical catchment work packages for operations support system(OSC) function



areas as NAIP is rolled out. As such they have a vital input to make to the agreed way forward, but must be seen to represent the entire catchment area. As a result of the last consideration, it is usual for the Implementation Board to ensure, by careful staff selection, that all the existing organisational units are seen to be allowed to participate in the implementation teams, not just staff from the District hosting the NOU.

PEOPLE—COMMUNICATIONS

Potentially, all staff engaged in network activities are affected by NAIP and they must be provided with enough information to understand, not only the technical side as it impacts on them, but also the underlying reasons for embarking on such a major project.

Various ways exist for keeping people informed and each has its merits. Newsletters are sometimes appropriate or articles published in in-house magazines or even special editions of technical journals!

These all have a place and are used to explain the concept and progress of NAIP. However, there is no substitute for face-to-face communications. These can be in the shape of local presentations and team briefs. The latter is often the most effective because the more personal NAIP is made, the closer one can get to everyone's question—how does it affect me?

A definitive answer, in most instances, cannot be given, but latest firm information and consensus views need to be shared to keep all involved up to a similar level of understanding to remove, as far as possible, any uncertainty. Openly explaining decisions that have been made and those where views are still being sought does much to gain individuals' commitment and drive to make the project successful.

The different aspects of work in the NOU and network field unit (NFU) need to be understood. Staff involved in NOU activities need to understand the work of an NFU and vice versa. The interface needs to be established and procedures agreed to ensure smooth and effective network operations and maintenance.

NOU SITE SELECTION

Another key area for NAIP roll-out is the need to select the NOU site. The many aspects of site selection can be grouped into two broad types; accommodation, and people/social.

For accommodation, the projected ultimate floor-space requirement (3000 m^2) must be available within the required time frame. The compactness of the space is important since it is clearly best if all the NOU accommodation is contiguous and not distributed around a large building. Suitability of accommodation for conversion to the NOU environmental standards must be considered. The ease of liberating the earmarked area is important because if equipment is difficult to move, the NOU may not be extendible within the preferred time-scales.

In the people/social context, staff access, public transport and car parking availability are all potential sources of discord. So too are inadequate welfare and recreational facilities.

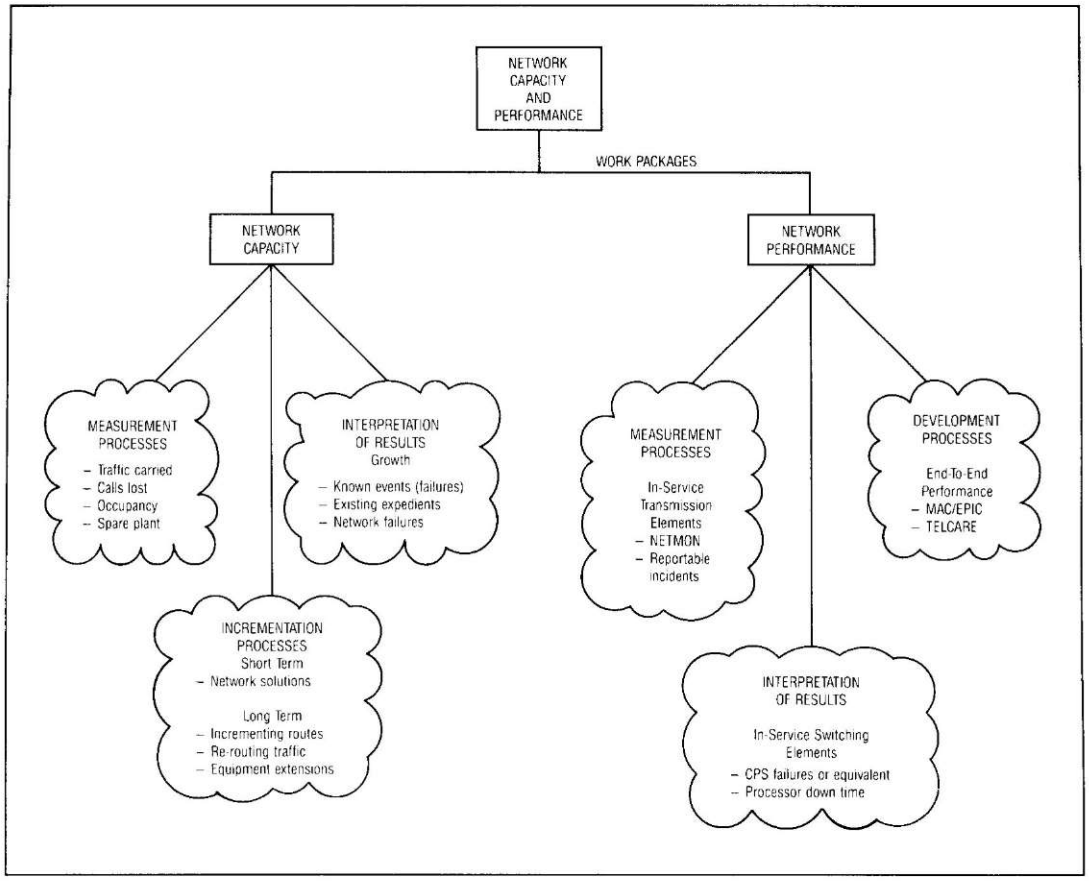


Figure 5
Typical catchment work packages for network control point (NCP) function

The availability of trained staff also needs consideration.

All these factors carry different importance weightings to be included in the decision analysis process to identify the best site. As local circumstances are inherently different and no two NOU catchments are the same, the location chosen for each NOU will have different attributes.

NOU STAFF SELECTION

The major physical change in the Platform is the introduction of the nine NOUs. Although they depend absolutely on the complementary establishment of the NFUs, the movement of staff to the NOU is a significant activity.

Staff employed in the NOU will require appropriate technical skills. This and other criteria will be the basis of staff selection. It is important to realise that all staff in the NOU catchment are eligible to join the NOU team, but when an identifiable job is moved into the NOU the current job holder will be given the option to move with the job.

CONCLUSION

A number of the key work areas that need to be carried out to prepare for Platform roll-out have been described. Although the work concerned is quite time consuming, and at times seems to hinder the project progress, in the end good groundwork pays dividends. On the Platform, the benefits of the groundwork put in by many people in the last two years are now being seen.

References

1 BEALBY, A. G. The Development of Network Administration in British Telecom. *Br. Telecommun. Eng.*, Oct. 1990 (this issue).

2 TRENT, D. R. Project Management and its Application to the Network Administration Programme. *ibid.*, Oct. 1990 (this issue).

3 CULSHAW, R. The Practical Issues of Network Operations Unit Piloting. *ibid.*, Oct. 1990 (this issue).

Biographies

Keith Richardson is a Head of Group in the NAIP Programme Management Office. He joined the then British Post Office (BPO) in 1972 as a Trainee Technician Apprentice in Newcastle Telephone Area. He took a part-time degree course and moved to Telecommunications Headquarters (THQ) in 1981 after success in the Assistant Executive Engineer Limited Competition. He has worked on various aspects of digital exchange maintenance policy and procedures, and was promoted to Executive Engineer in 1984 and Head of Group in 1986. In 1988, he moved to head the NAIP Tranche Support Group.

Dick Silk is NOU Implementation Project Manager for Northern Home Counties. He joined the then BPO in 1965 as a Youth-In-Training in Tunbridge Wells Telephone Area. He moved to THQ in 1970, working on national and international standards for signalling systems. He joined the System X Launch Unit and worked on OMC development, and then moved into National Networks Head Office working on network operations policy and procedures. In 1985, he moved to Cambridge and took a Level 3 field manager post in Trunk Network Operations East.

Future Developments in Network Administration

A. G. HANDSCOMBE, M. K. SOODAN, and D. G. C. MILLS†

This article gives a broad view of the current state of network administration and the key drivers for change in terms of customer expectation and telecommunications carrier business needs. The implications of changing requirements on organisational structure, the type of work and the people involved are outlined, along with the impact of common architectures, equipment capabilities and computing developments on systems. Finally, brief views are given of functions and capabilities in the medium and long term.

INTRODUCTION

Network administration encompasses the people and systems involved in planning, building and, perhaps most visibly, operating the network.

Whatever new technologies are deployed or services offered, it is the task of network administration to pull together the components of the network to provide the required functionality and quality, while minimising the whole-life network costs; that is, making best use of capital invested and, equally important, controlling the current account costs of providing and maintaining service.

BACKGROUND

Network Administration To Date

The telecommunications networks of the recent past are characterised by a multiplicity of fragmented support systems; these give rise to overlaps in their functions, multiple interactions between systems and staff, and consequent inefficiencies. Typically, in 1987, BT identified about 150 support systems in use in its UK network. By the end of the 1980s, it was generally recognised that fewer systems were needed and that an integrated approach to those systems was necessary. This would enable them to serve the whole network and all product and service needs. These systems must be coupled with a properly defined work management system to facilitate better utilisation of field staff.

The demands of this integrated-systems approach, together with the need to link support systems to processor capabilities in network equipment, strengthened the requirement for network-management standards, and the move towards a defined architecture, as instanced by the development of BT's strategic Co-operative Network Architecture for Management (CNA-M).

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Network Equipment Evolution and Trends

In parallel with the above trends, new more-reliable equipment requiring minimum human intervention and providing increased functionality is being developed and deployed in the network. This equipment will increasingly conform to open standards which will reduce its development cost and time-scales, and allow it to be introduced more quickly into the network. However, this will only produce operating cost savings and improvements for the customer where the equipment can be managed remotely via network management systems operating within an efficient and flexible service organisation, handling provision and repair activities.

DRIVERS FOR CHANGE

The major drivers for change in network administration can be split into two broad categories: those addressing the needs of the customer of the future, and those dictated by business needs.

Customer Needs

Network operators and service providers will continue to be faced with rising customer expectations on the following fronts:

Quality of Service

Even for the most basic plain old telephone service (POTS) and leased-line services, improvements will be expected in:

- flexibility and speed of provision (response in hours not days),
- in-service reliability, and
- network fault restoration times (restoration in minutes).

New and More Sophisticated Products and Services

Customers' applications will become more automated, demanding a higher degree of functionality from communications networks, as more computing is used in day-to-day operations. This

will be coupled with the availability and use of increasingly complex functionality in customer terminals.

Spurred on by the above, and by new network technology in the customer-apparatus (terminal) market, the range of network services will continue to grow in both functionality and complexity.

Service Management

The product life cycle and product-launch period of new services will, in general, be much shorter (product life cycle of a few years, launch period measured in months). This rapid response to market drives will be needed in order to maintain a competitive edge.

In this environment, services themselves will need to be managed to achieve quicker, more flexible, implementations. Network administration will play a key role in this management of services particularly as order handling, billing, etc., is on the critical path of new service introduction.

Increasing Demand for International Services

Traditionally, PTTs and Telcos have dominated the market within their own geographical domains, forcing customers to negotiate services from several network operators in different countries. One-stop shopping for both provisioning and maintenance will be increasingly viewed as the norm.

Customer Network Management

The 1990s will see the emergence of network management as a product in its own right. This will apply particularly in the corporate sector where there is an increasing awareness of the importance of communication networks to the profitability, and even survivability, of their business. These organisations look to network management to provide them with a strategic advantage over their competitors through:

- effective, on demand, control of the configuration of their network and optimisation of network capacity;
- accurate management information on current configuration, usage, billing, service status and performance, presented in a form tailored to their individual needs; and
- reduction in their own operating cost (staff and systems), for managing multi-vendor public and hybrid networks.

In order to meet these objectives, companies will require seamless, integrated management solutions ranging from network management systems that integrate multi-vendor equipment, to a complete network 'facility' management service responsible for the whole network and service life cycle across both public and hybrid networks.

Business Needs

While the success of any telecommunications business depends on satisfying its customers in terms of service offerings, this must be achieved within an attractive tariff and quality-of-service framework. In the competitive environment of the future, continuous effort will be required to reduce operating costs while improving quality.

To achieve this, major improvements in the way the network is administered and operated are required. Methods must be found which:

(*a*) enable better use of manpower,
(*b*) reduce procurement and whole life costs,
(*c*) reduce the number of management systems supported, and
(*d*) provide a faster, more flexible, response to customer demands (for service provision and problem resolution).

Additionally, competition between network operators will drive price and quality differentials down. As this happens, one of the principal differentiators between operators, and hence the major influence on customer take-up of services and retention of market share, will be the functionality (management capability, configurability on demand, etc.) offered by each supplier. The enabling of this functionality is a further driver for the development of network administration processes and systems.

REALISATIONS

With the advent of digital technology and processor control, significant progress has been made in the past decade towards achieving remote operations and management. In British Telecom's network, about 50% of POTS customers (personal and business) and 100% of digital private-circuit customers are served using core network equipment which is managed remotely. The current focus amongst worldwide network operators is to achieve front-office integration with presently available remote operations and workforce management systems.

Ultimately, almost all information and work flow will become automated, reducing manual intervention to the taking of customer orders, and to provision and maintenance of services and network equipment in the field. Such a high degree of automation will be heavily dependent upon effective development and use of computer technologies, standards, and the people involved.

Inevitably, this will have a major impact on organisations, their culture and their expectations of their workforces. It will also place a heavy reliance on integrated network management systems to meet the new market demands.

People Issues

The network administration and operation environment of the future will have effects on staff which can be categorised under three broad

headings: organisation, type of work, and type of staff needed.

Organisation

The current trend towards centralisation of management of the network will continue, enabled by the increasing proportion of network elements with remote management capability, the increasing sophistication of support systems and their continued integration.

Centralised units will be the focus for the handling of network events (alarms), traffic management, service provision and performance monitoring, and, either manually or using support tools, will analyse the actions required. They will be manned 24 hours a day, 365 days a year and control the task allocation and progress of the field force via workforce-management systems. In order to increase the speed of reaction to network events, systems will be developed to analyse events automatically, and distribute tasks accordingly.

Field staff will be increasingly mobile, organised into field units (organisational entities rather than physical locations) to be directed by central units to respond quickly and flexibly to meet the customer's need.

Type of Work

The type of work undertaken by centralised network-management staff will continue to move away from manual and paper-based tasks towards information technology (IT)/screen-based activities, such as software support, data build and data manipulation. Increasing use will be made of expert systems to assist staff in analysis and diagnostic work, and speed reactions to events in the network. Additionally, with the advent of customer specific networks (virtual private networks, etc.) and facilities management, network-administration staff will act as agents for customers, or enable the front office to act, to provide management services.

In the field, local faulting activity will decrease as support tools provide detailed diagnosis, fault location and fault correction or bypass. Similarly, manual provision of service work will decline as remotely controllable network elements and pre-provisioned access plant enable a remote configuration capability.

The advent of self-healing networks, together with automated testing, routine testing, diagnostics and monitoring, will significantly reduce the amount of reactive effort. The work emphasis will change towards customer-focused activity, particularly concentrating on proactive work to rectify or circumvent network problems before they affect the customer.

Type of Staff

Network-administration staff of the future will be highly trained with a good knowledge of the network plant they control, of support tools and the capabilities they offer, and of the relationship between network plant and the services it supports.

Customers will expect one-stop shopping for telecommunications services, service on demand and a single contact point for fault and service enquiries. Front-office staff will need to understand, and be able to provide, integrated solutions to customer service requests, and circuit-status reports and fault progress to customers. To achieve this, access will be available to configuration and fault support systems to enable on-line confirmation of orders, plant allocation, remote configuration, remote status (alarm) monitoring and reconfiguration if necessary.

Workforce-management systems will correlate problems against skills profiles to ensure that appropriate staff are dispatched. Even so, field technicians involved in customer contact will be expected to deal with a full range of a customer's service problems. Repeated visits by a succession of engineers will be unacceptable to tomorrow's customer. To facilitate this, training, electronic documentation (records, manuals and procedures) and help desks will be available in support of services and technologies.

Support systems and expert systems will reduce routine work and some analysis and faulting activity. However, there will be an increased demand for newer skills to manage the increasing complexity of the network, the variety and integrated nature of product and service offerings, and the speed with which those offerings are introduced. This will demand a highly trained, competent staff if full benefit is to be gained from network administration and operation.

Demographic trends suggest that there will be a scarcity of such staff, given declining numbers of people entering the labour pool and the increasing demand for such staff being made by other businesses. Thus, significant effort will need to be directed to new-entrant training, to update training for existing staff and to their retention.

Systems

The changes required of network administration to support future operations are encompassed in architectural, network equipment and computing developments. The functionality developed is considered in the short-to-medium term (up to 5 years), and medium-to-long term (6 years and beyond).

Architectures

Inter-operability with multi-vendor equipment, and other co-operating network operators, will be achieved by deploying operations, systems and network equipment within common architectures which define a functional, structural and interface framework.

This architectural approach will provide:

(*a*) independence between the development of services and the network realisation,

(*b*) the infrastructure for the realisation of one-stop shopping and customer network management, and

(*c*) transparency between network management and the intricacies of individual network technologies.

At the current pace, it will take a decade or more before significant integration and flexibility are achieved in network management because of the long development cycles, the intricacies of individual network technologies, and the difficulties of migrating from the current systems. Additionally, the movement toward architectural standards is hampered by the difficulty in demonstrating short-term financial justification which accompanies any long-term infrastructure development which is not primarily revenue earning.

However, emerging development techniques, computing technologies, and industry-wide agreement on standards will reduce the development cycles and costs, and make migration easier.

Within BT, an architecture called *Co-operative Network Architecture for Management* (CNA-M) has been adopted. This builds upon the OSI/Network Management Forum work to achieve an inter-operability and co-operative capability, while still allowing BT to add its own value and keep its competitive edge.

Equipment Capabilities

Increasingly complex diagnostic capabilities will be incorporated within the equipment. These diagnostics will enable faults to be detected automatically, with fault resolution being very precise. These enhanced diagnostics, together with the existing monitoring and testing capabilities, will form the basis for developing integrated network management systems.

Remote configuration capability will be supported by a wider range of equipment and will spread beyond the core of the network ever deeper into the access network.

The main technologies that will be deployed or enhanced to support these capabilities include:

(*a*) integrated services digital network (ISDN), fibre, data links, etc., in the local loop;

(*b*) digital switches and cross-connects, packet switches, synchronous transmission equipment, and wide area networks (WANs), etc., in the core network; and

(*c*) advanced terminal equipment, local area networks (LANs), etc., in customer premises.

Line testing of digital circuits will become complex but more economical through the use of centralised test access and common test heads. In the short-to-medium term, digital line testing will be integrated with the existing testing for copper circuits.

Computing Technologies

Object-oriented techniques will be used for all stages of computing developments. The specification of complex systems will be easily understood and realised, and a vast amount of software code will be re-usable from previous developments. Use of the industry-wide agreed standard tool set (for example, conformance testers) and languages (C^{++}) in the development environment will be the norm. All this will have a major impact on the reduction of development time-scales for systems from years to a few months.

UNIX will be the agreed industry standard for the computing platform on which management systems will run. Additionally, the standards and technologies to support distributed processing and integrated databases will develop significantly. Together, these will maximise the skilled labour available to system developers and users, make the usage of computing power more efficient and make future system migrations easier.

X Open will become the norm for user interfaces. This will provide a major improvement in the user friendliness of computers by making the graphical user interface (GUI) the norm, and do so at a more economical cost.

Major progress will be made in the implementation of standardised interfaces between operations systems and network equipment (via element managers). This will lead to fierce competition in the equipment market (more competitive procurement) and in service offerings from network operators. It will also ease the introduction of new management service offerings from network operators.

There will be a major reduction in the cost of interprocessor communications through the use of new technologies (for example, ISDN, fibre), and owing to growth in the volume of data transfer and reducing tariff for data networks.

Short-to-Medium-Term Developments

The following administrative functions will become automated:

(*a*) centralised fault reception and monitoring,

(*b*) simple correlation of events,

(*c*) service restoration through re-configuration,

(*d*) centralised traffic monitoring and control,

(*e*) testing and diagnostics,

(*f*) selective (service-specific) front office integration with network management,

(*g*) integrated network capacity allocation and monitoring,

(*h*) network data management,

(*i*) workforce management, and

(*j*) electronic manuals.

Customer network management capabilities will be available for:

(*a*) centralised control and network surveillance,
(*b*) on-demand reconfiguration,
(*c*) Centrex lines moves and changes,
(*d*) status and billing enquiries,
(*e*) facilities manipulation (for example, 0800), and
(*f*) network 'facility' management service.

These will apply across a variety of multi-vendor equipment located on multiple sites, and for hybrid and public networks (switched, leased or packet) for voice and data.

Medium-to-Long-Term Developments

Artificial intelligence will play an increasing role. The complex, infrequent and non-repetitive operations (where individual system developments are neither practical nor justified) will now be able to exploit the capabilities of the expert systems.

The following administrative functions will become automated:

(*a*) network design and planning,
(*b*) on-line training and help utilities,
(*c*) inventory management,
(*d*) works order programming,
(*e*) correlation and diagnosis of complex faults and problems,
(*f*) performance management, and
(*g*) cost or benefit modelling to aid day-to-day operations.

Customer network management capabilities will be available for:

(*a*) service creation within an intelligent-network environment,
(*b*) bandwidth selection, and usage optimisation,
(*c*) testing, and
(*d*) management of visual services.

CONCLUSIONS

The successful development of network administration will be crucial to the health of future telecommunications providers, enabling, as it does, cost reduction, quality improvement and increased functionality. Companies which fall short of the network-administration standard will suffer high costs and slowness of response, both to customer request and in new service introduction, which will inevitably lead to loss of market share and decline.

As the network grows in size and complexity, it will be the effectiveness of network administration coupled with new services derived from the network management capabilities that will provide an important competitive edge for network operators and service providers.

Biography

Tony Handscombe joined the GPO in 1963 as a Youth-in-Training. He has worked predominantly in the District, in the transmission field, in both a maintenance and works capacity, and more recently in transmission network support within Network HQ. He is currently an analyst in the Network Strategy Unit, BTUK, working on network operations and management strategies for operations and the support of network equipment, in the BTUK network.

Madhoo Soodan, joined BT in 1971 as a trainee technician apprentice. In 1977, he obtained a B.Sc. Honours degree in Electrical and Electronic Engineering from the University of Newcastle-upon-Tyne. He has held a number of digital exchange support posts covering software and data management, in-service support, system integration and testing, performance monitoring and improvement, and support systems. He is currently a strategic analyst working within the Network Strategy Unit on systems architectures, standards, and operations-systems studies for network operations and management in the BTUK network.

Dave Mills joined the BPO in 1971 as an open competition Assistant Executive Engineer. He has held various posts in network planning, System X planning and development and analysis of network economics and is currently head of the Network Operations and Management Strategy group. He holds a B.Sc. in Physics and an M.Sc. in Communications Engineering.

British Telecom's Worldwide Network Management Centre

BRITISH TELECOM PRESS NOTICE

British Telecom's new £4M Worldwide Network Management Centre at Oswestry, opened in September, enables BT instantly to pinpoint trouble spots in its inland and international networks and remedy many problems before they reach customers.

At its heart is the management floor, where up to 30 network managers, on duty 24 hours a day, sit at specially designed consoles which give them continuously updated information on the status of the networks and the flow of calls through them. They act immediately if trouble looms to protect the networks against congestion.

Maps and charts on a constantly-changing video wall—at 25 m long, the largest in Europe—give up-to-the-minute pictures of how the networks are performing and highlighting potential trouble spots.

The centre was opened by Mr. Anthony Booth, currently Managing Director British Telecom International, but who is soon to become managing director of the company's new Worldwide Networks division.

He said: 'This new centre—the most advanced of its kind in the world—is a vivid demonstration of BT's pre-eminence in network design and management. Every part of the underlying systems which take data from the network and process it for display was designed and specified by our system and software engineers. It is an overwhelming testimony to their skills and expertise, which we are now selling to overseas operators.

'This centre, and the control over the network it gives us, is a direct result of our huge £2 billion a year modernisation programme. It is no coincidence that I am able to open the centre within a couple of months of our national trunk network becoming wholly digital. The two go together hand in glove.

'The digital trunk network also gives very-high quality levels. Currently, more than 99% of calls over the network are successfully handled on first attempt without problems caused by equipment faults or congestion.'

Managers can re-route calls to bypass congested areas, increasing the chances for calls to get through to other destinations. They can also take advantage of different time zones to route international calls over less busy routes. For example, in the morning, calls to Europe may well go via the USA, while users there are still sleeping.

The Worldwide Network Management Centre currently monitors all of BT's processor-controlled System X exchanges—57 in the trunk network and 373 local units. By 1995, this number will have grown to about 700, while there will then be 69 trunk switches. The centre also monitors the company's three digital

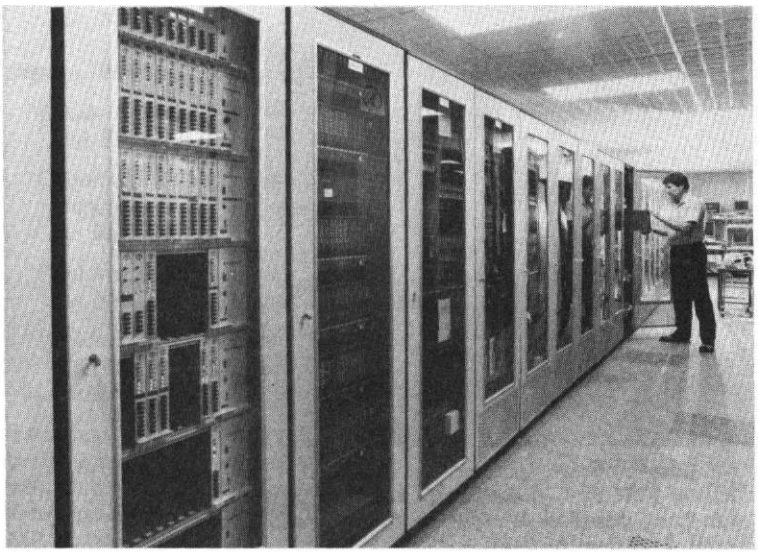
BT's Worldwide Network Management Centre

Network manager's console (including touch screen to give access to telephone lines connecting them to local operations rooms around the country)

international exchanges and 1500 routes linking its UK network to 199 countries overseas. In comparative terms, British Telecom's digital network is more comprehensive than that of any other major operator.

The processors which control the exchanges monitor their performance and generate data detailing the number of calls made, their destinations and duration. This network usage data is transmitted to the management centre at five minute intervals to tell managers how the network is performing and is essential for network control and planning. It allows managers to spot routes on which call growth is likely to outstrip capacity, so that early action can be taken to provide extra equipment in good time.

Data about network usage arrives at these data-line terminals



The data is available only as a result of modernisation. The old electromechanical exchanges, which BT is now replacing as rapidly as it can, worked in isolation. Each was responsible for checking its own operation and the condition of the lines connected to it. There was no overall picture of the state of the network, except in retrospect.

The volume of data collected from the network is huge. In each 5 minute period, 4 Mbytes of data arrive at the centre. The data forms the basis for displays on the video wall of maps of the UK and other parts of the world, along with data tables, events diaries, incident reports and other information, which give up-to-the-minute pictures of how the network is performing. Where the data indicates a potential problem, the relevant route is flashed up in colour on the appropriate map on the video wall. Different colours signify the degree of severity of the trouble.

At their consoles, network managers can call up a map of the network, and zoom in on any part of it to give them a detailed view of what is happening in that locality.

Similar facilities also extend monitoring to the nine 5ESS switches which make up the digital derived services network, which supports BT's LinkLine, Advanced LinkLine and CallStream services.

Software enhancements are now being developed to allow BT's local AXE10 digital exchanges to be monitored from the worldwide centre. By 1995, there will be about 150 AXE10 processor sites under the centre's control.

However, managers at the Worldwide Network Management Centre are able to control all the exchanges in the network. This allows them to change the way the exchanges handle calls to overcome congestion or remove from the network calls which would fail.

The centre also manages network outage—the failure of transmission links resulting, for example, from damage by trenching or other excavations. More than 10% of BT's long-distance transmission network is kept instantly available on stand-by for such situations, benefiting private circuit customers as well as users of the public network.

When a live system fails, an alternative path is created by patching together appropriate sections from this digital service protection network. Increasingly, the patching is effected by automatic switching to ensure virtually instant service restoration. For overseas calls, a service protection network is also provided, in collaboration with overseas operators, as a safeguard against failures of international transmission links. The centre directly co-ordinates such restoration activity.

The centre generates many of the recorded service information messages which tell users about network situations, such as the new dialling codes for London introduced in May. Later this year, it will take over responsibility for the speaking-clock announcements.

29th European Telecommunications Congress, Glasgow, August 1990

INTRODUCTION

This year's annual Congress of the Federation of the Telecommunications Engineers of the European Community (FITCE) was held for the first time in the UK and was hosted by the Institution of British Telecommunications Engineers (IBTE). Considerable preparatory work is needed to manage the financial, human and material resources required to produce an event of such magnitude. It was therefore decided almost two years ago that Brian Wherry, as Vice-Chairman of IBTE and Vice-President of FITCE, should lead a team of IBTE members and supporters in ensuring that the first UK FITCE Congress was a success.

PLANNING

The immediate issue to be resolved was that of a venue. Although many options were feasible, it was decided to hold the Congress in Glasgow. Subsequently, it was announced that Glasgow had been awarded the accolade of becoming the European City of Culture for 1990—a useful spur in the promotion of this venue with our European colleagues. The choice of Glasgow also necessitated the direct involvement of BT West of Scotland District staff for local support. In particular, Bill Robertson was assigned to help manage the numerous detailed arrangements necessary for the smooth running of a prestigious conference.

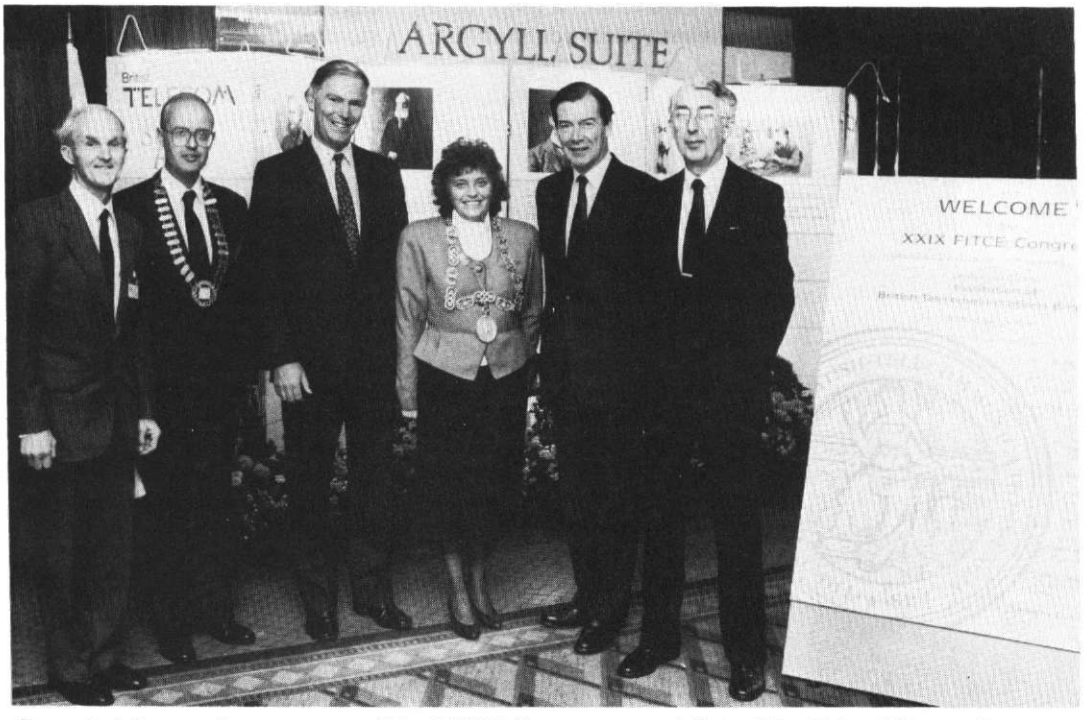
One of the first problems to be solved was the siting of the Congress in Glasgow. A venue was required that would accommodate a large audience of over 600 delegates and their partners, conference facilities and committee rooms, and have the capacity to provide reception and dining facilities. Fortunately, a new hotel complex, The Forum Hotel (latterly renamed the Moat House International) was being built close to the city centre and alongside the Clyde. During the early stages of construction, agreement was reached with the hotel management to accommodate the Congress at the hotel.

As planning for the Congress began to develop, a clear need was established for a project management support process. Colin Shurrock, Chairman of Council, IBTE, agreed to adopt BT's internal project management processes, which became very effective in controlling the numerous tasks to be completed.

Each Congress is assigned a central theme for debate. This year's theme was: 'Networks 2000—Developing Telecommunications Networks towards the year 2000, to meet the National and Global needs of European Customers, specifically in the Fields of:

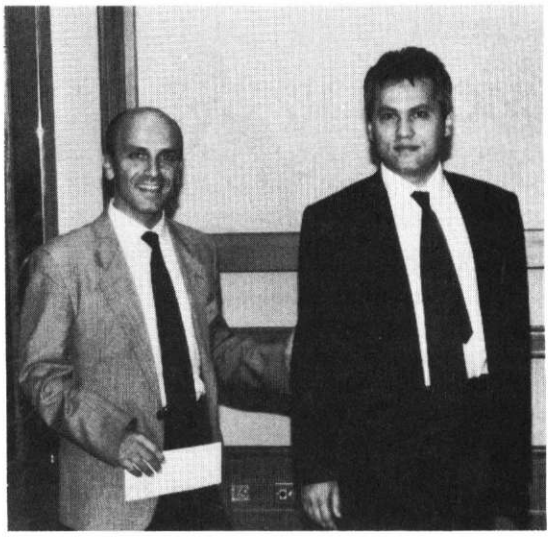
- Customer Services,
- Operational Management Systems,
- Network Architecture, and
- Personal Communications.'

The scope of this theme encouraged a considerable number of papers to be offered. To ensure a high standard was achieved for presentation at the Congress, it was decided to introduce for the first time a paper selection committee which had the unenviable task of choosing just 33 papers from a field of 58.



Present at the opening ceremony of the FITCE Congress were, left to right, Brian Wherry, Congress organiser; Peter Hamelberg, President of FITCE; Iain Vallance, Chairman of BT; the Lord Provost of Glasgow, Susan Baird; Ian Lang, Minister of State for Industry and Education; and Clive Foxell, President of IBTE

One of the BT delegates, Forbes Hamilton, delivering the joint paper 'Remote Rural Modernisation in the UK'



Messrs. F. Parente and A. Palamidessi, authors of the prize-winning paper

OPENING CEREMONY

With all preparations complete, the Congress began with its opening ceremony on the morning of 27 August 1990. It included welcoming speeches from Clive Foxell, IBTE President; Ian Lang, Minister of State for Industry and Education; the Lord Provost of the City of Glasgow, Susan Baird; Peter Hamelberg, President of FITCE; and Iain Vallance, BT Chairman.

TECHNICAL SESSIONS

With the conclusion of the opening formalities, it was quickly down to work with the presentation and debate of the technical papers. The technical programme was arranged into sessions covering the four specific topics of the Congress theme, together with an introductory session of keynote papers from the UK, Italy, West Germany and the EEC Commission.

As usual, a strong team of IBTE members presented technical papers, all maintaining the high standards delegates have come to expect from the UK. Six papers were presented including two keynote papers:

Keynote Papers

'Meeting Customer Needs in a Changing Environment' by W. G. T. Jones.

'Modernisation of the London Network' by W. Medcraft, and B. Haigh.

Session Papers

'British Telecom's ISDN Implementation' by J. Marshall, and F. Welsby.

'Operation, Administration and Maintenance of Personal Communications Services and the Intelligent Network' by A. Batten.

'Deployment Strategies for Transmission Networks Based on the Synchronous Digital Hierarchy' by T. Wright.

'Remote Rural Modernisation in the UK' by F. R. C. Hamilton, A. J. McDonald, J. S. Dixon, and S. A. Mohamed.

Each year, a paper from the Congress is awarded the President's prize. The prize-winning paper for this year's Congress was 'The New Telecommunications Network: Architecture and Development Criteria' by F. Parente and A. Palamidessi from SIP, Italy.

All but one of the papers presented at the Congress were published in the August 1990 special FITCE Congress issue of the *Journal*.

ROUND TABLE DEBATE

The technical programme was concluded with a round table debate at which leading figures in the European telecommunications field presented their views for open debate. The debate was chaired by Sir Eric Ash, Vice-President of IBTE, and other speakers were Robert Faulkner of ICI, Gert Hausmann of the West German Ministry of Posts and Telecommunications, and Alan Rudge, British Telecom. The topic for discussion was

Chairman of the Operational Management Systems Session, Joe Dwyer (right), and his assistant, Keith Morgan

Round Table in session. From left, Gert Hausmann, Sir Eric Ash, Robert Faulkner and Alan Rudge

'Are the requirements of the European customers being fully anticipated and satisfied by today's response from the telecommunications industry?' All four speakers gave a wide-ranging and thought-provoking presentation of their views and concerns generating an interesting and enthusiastic debate with the delegates.

TECHNICAL VISITS

The work of the Congress was also supplemented by a varied programme of technical visits. Delegates were able to choose, according to their interest, from visits to BT East and West of Scotland Districts, Digital Equipment Scotland, Hewlett-Packard Ltd., GPT, Bank of Scotland, Philips-TMC and BICC-Brand REX.

Each of these companies were sponsors of the Congress along with Amdahl, AT&T Network Systems UK Ltd., STC plc, Northern Telecom Europe Ltd., and Ericsson.

CULTURAL PROGRAMME

In addition to providing a forum for the interchange of technical information, a key aim of the FITCE Congress is to provide delegates and their partners with an insight to the cultural life of the host country. For accompanying partners, a programme of visits was arranged throughout the week involving visits to Glasgow city centre—its buildings and galleries, to Edinburgh and to Loch Lomond. Delegates were also able to sample with their partners aspects of Scottish cultural life. The first evening of the Congress was spent as guests of the Lord Provost and Council of Glasgow at a reception at the City Chambers. Guests were piped in to the entrance of this imposing Renaissance building with its mosaic ceilings, statues and marble staircase.

One of the world's finest collections of antiques and fine art from Europe, the Eastern Mediterranean and China is housed in Glasgow at the famous Burrell Collection. The collection was the venue for FITCE guests to appreciate some of the considerable historical artefacts Glasgow has been able to exhibit at its museums and galleries. Further classical appreciation was also provided by an evening at the opera with a performance of Puccini's *Tosca*.

Finally, a short visit to Blair Castle in Perthshire was provided where an exhibition of the latest digital telecommunications systems and their applications in the Scottish Highlands, organised by BT's North of Scotland District, was displayed.

Outgoing FITCE President Peter Hamelberg and new President Colin Shurrock

FITCE GENERAL ASSEMBLY

The concluding event of the Congress is the General Assembly of FITCE, which this year was of particular interest to IBTE delegates. In recognition of his many years of resolute effort on the FITCE Comité de Direction, Brian Wherry was awarded Honorary Membership of FITCE, a recognition warmly appreciated by delegates. The election of members of the Comité de Direction of FITCE also takes place at the General Assembly. Peter Hamelberg of the Netherlands has been President of FITCE for the last two years. His tenure of office came to an end at the end of the Congress, and he handed over his chain of office to his successor, Colin Shurrock. Peter was given a warm send off from the delegates. Finally, Chris Seymour was elected as the UK member on the Comité de Direction, together with Andy Valdar as his deputy.

CONCLUSION

At the end of both an interesting and exhausting week, it was pleasing for IBTE delegates to receive the congratulations of European colleagues for providing, at its first attempt, a most successful Congress. The technical papers had been well received, the selection process proving its worth. All the supporting activities had been effectively managed with few problems, and even the weather went according to plan! High standards were achieved and our customers were satisfied. Next year's Congress will be held at Strasbourg. Our best wishes go to the French national association, who will host the Congress.

R. A. WARD
Member of the FITCE Congress Organising Committee
Chairman, IBTE Lancs and Cumbria Centre

THE INSTITUTION OF BRITISH TELECOMMUNICATIONS ENGINEERS

(Founded as the Institution of Post Office Electrical Engineers in 1906)

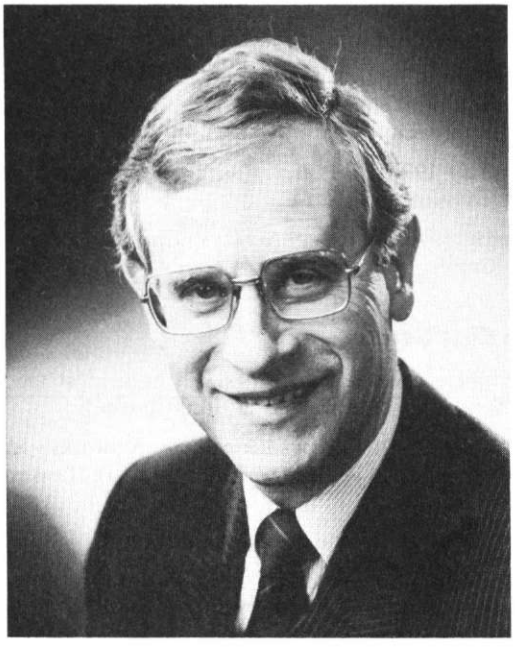
General Secretary: Mr. J. H. Inchley, NPW9.3.P, 1C18, The Angel Centre, 403 St John Street, London EC1V 4PL; Telephone 071–239 1912. Membership and other queries should be addressed to the appropriate Local-Centre Secretary as listed on p. 222 of this issue of the *Journal*.

NEW IBTE PRESIDENT

The IBTE's new President is Dr. Alan Rudge, O.B.E., F.ENG., F.I.E.E., F.I.E.E.E., F.R.S.A., Managing Director, BT Development and Procurement. The formal transfer of the IBTE Presidency from Clive Foxell was made at the *Journal*'s award ceremony, which took place on 26 September 1990 at the BT Marketing Prototype Centre in London.

Alan Rudge became Managing Director Development and Procurement for British Telecom in April 1990. Born in London in 1937, he received his formal engineering training at the London Polytechnic and the University of Birmingham, where in 1968 he obtained his Ph.D. in Electrical Engineering. After spending several years at IIT Research Institute in the United States, he returned to the UK to join the academic staff of the University of Birmingham.

In 1974, he joined ERA Technology Ltd, becoming a Director in 1979; he was appointed to the position of Managing Director later that year. He joined British Telecom in January 1987 as Director, Research and Technology. In April 1988, he was appointed to the British Telecom Management Board and in 1989 to the Main Board as Group Technology and Development Director. In April 1990, he was appointed Managing Director of the newly created Development and Procurement Division and his responsibilities were extended to include Group-wide responsibility for Information Technology, Computing and Procurement in addition to Technology and Development. With more than 13 000 staff the Development and Procurement Division provides the Group's Computer Operations, Information Systems Development, Network Technology, Advanced Applications and Services Development and Procurement Services which acquire more than £2 billion of equipment annually.



Alan Rudge, new IBTE President

Dr. Rudge has served on a number of research advisory bodies in the UK including the Cabinet Office Advisory Committee on Science and Technology, the CBI Research and Manufacturing Committee and the DTI IT Advisory Board. He is a visiting Professor and external examiner at the University of London, a Vice-President of the Institution of Electrical Engineers and a past Member of the Council of the Fellowship of Engineering. He was awarded the OBE in 1987.

Clive Foxell took over as President of the Institution on the retirement of Ron Back in May 1988. He took an active role from the start, responding to the difficulties IBTE were then facing in a totally positive and supportive way. He was instrumental in creating the President's Advisory Group, pulling together members of the main BT Board and all the senior engineering managers throughout British Telecom, which has proved invaluable in demonstrating BT's support for IBTE, as well as generating new ideas and impetus.

Clive further demonstrated his commitment to the Institution by his active and enthusiastic involvement in the first IBTE Congress, presiding over, and participating in, the activities and at the dinner. His recent participation in the FITCE Congress in Glasgow, where he represented the IBTE, paid further testimony to his commitment to the aims and objectives of the Institution. He has been an invaluable friend to the Institution, and we are grateful to him for all he has done for us.

IBTE TIES

IBTE ties are now available in a choice of two designs and in two materials: polyester, priced at £4·00 each, and silk, priced at £13·50. Order forms are available from Local-Centre Secretaries.

IBTE LOCAL-CENTRE PROGRAMMES, 1990–91

Aberdeen Centre

Meetings (except for March) will be held in CCC, 9 Bridge Street, Aberdeen, commencing at 14.00 hours.

4 December 1990: *Inside the Black Box—Energy Management Systems* by S. Brewis.

8 January 1991: *British Rail Signalling Systems (developments from past to present day)* by C. Leterche, British Rail, S & T Engineering, London.

5 February 1991: *A Glimpse of the Future—An insight into Martlesham* by Dr. T. Rowbotham, Director Networks Technology.

20 March 1991: Joint meeting of all Scottish Centres and North East Centre in Edinburgh. Talk by Bruce Bond, BT Group Products and Services Director.

East of Scotland Centre

Except where stated, meetings will be held in Room 340/1/2, Telephone House, 356 Gorgie House, Edinburgh.

23 November 1990: *Future Services on System X* by A. McCulloch, GPT. Commences at 12.00.

20 March 1991: Joint meeting of all Scottish Centres and North East Centre in Edinburgh. Talk by Bruce Bond, BT Group Products and Services Director.

East Anglia Centre

21 November 1990: *The Network* by K. Ward, Chief Network Engineer, BTUK. To be held in 3rd Floor, Conference Room, St Peter's House, Colchester, 12.30–14.30 hours. Buffet lunch at 12.00 hours.

16 January 1991: Three short papers by Members. To be held in Committee Room No. 1, Civic Centre, Victoria Avenue, Southend-on-Sea, 14.00–16.00 hours.

20 February 1991: *Links Around the World* by A. Booth, Managing Director, British Telecom International. To be held at Lecture Theatre No. 5, Essex University, Colchester, 14.00–16.00 hours.

20 March 1991: *Quality in Engineering* by R. Mackrill, Operations Director, Lotus Cars. To be held in The Music Room, Assembly House, Theatre Street, Norwich, 14.00–16.00 hours.

17 April 1991: Joint meeting with Bletchley South Midland Centre by Dr. A. Rudge, Managing Director Development and Procurement, BT. To be held in The Council Chamber, The Guildhall, Cambridge, 14.00–16.00 hours.

East Midlands Centre

16 January 1991: *O.S.C.A. Structured Wiring* by M. Leah. To be held at Nottingham University, commencing at 14.00 hours.

20 February 1991: *Network Forum* by A. Harris, EMD/E. To be held at Leicester University, commencing at 14.00 hours.

13 March 1991: *Works Management Programme* by D. Beattie, FOS/WM. To be held at Nottingham University, commencing at 16.00 hours.

London Centre

23 November 1990: *Project Management* by Linda Ward, BTUK Programme Office Controller. To be held at Assembly Rooms, Fleet Building, 40 Shoe Lane, London EC2V 3DD, commencing at 12.45 hours, buffet from 12.30 hours.

8 December 1990: Family Christmas Lecture—*A Man for all Seasons* by Bill Giles, BBC Weather Forecaster. To be held at The Institution of Electrical Engineers, Savoy Place, London WC2. Morning session: 11.00 hours; afternoon session: 14.30 hours. Refreshments available 30 minutes before each session. Admission strictly by ticket. Free tickets can be obtained by application in writing to: 1990 Christmas Lecture Office. Room 445, Williams National House, 11–13 Holborn Viaduct, London EC1A 2AT., enclosing a self-addressed envelope to an office address.

Liverpool Centre

Except where stated, all meetings will be held at the Bradford Hotel, Tithe Barn Street, Liverpool, commencing at 14.00 hours.

21 November 1990: *Derived Services—The Evolving Network* by K. Tabor.

16 January 1991: Joint meeting with Manchester and Lancs and Cumbria: *Evolution of Worldwide Networks* by A. Booth, Managing Director, Worldwide Networks. To be held in the UMIST Building, London Road, Picaddilly, Manchester, commencing at 13.30 hours.

14 March 1991: *The Battleground of the 90s* by A. Kane, Director Operations (North) Worldwide Networks.

15 May 1991: *A Glimpse of the Future* by Dr. T. Rowbottom, Director Networks Technology, BT Development and Procurement.

Martlesham Heath Centre

Meetings will be held in the John Bray Lecture Theatre, British Telecom Research Laboratories, Martlesham Heath, commencing at 16.00 hrs.

13 November 1990: *The Development of the Harrier Family of Aircraft* by J. F. Farley, BAE (retired).

20 November 1990: *The Home of the Future* by Dr. T. F. Smith and G. Hudson, British Telecom Research Laboratories. Entrance by ticket only (available from Martlesham Heath Secretary).

North Downs and Weald Centre

Except where stated, meeting will be held in Medway Suite 2, Crest Hotel, Maidstone Road, Chatham commencing at 14.00 hours. Refreshments from 13.00 hours.

20 November 1990: *Other Licensed Operators* by M. Elliot and T. Sharp.

6 December 1990: *Highways Planning* (roads etc.) by R. Martin-Royle, Core MFCP Manager. To be held in the Sterling Suite, Crest Hotel, Maidstone Road, Chatham.

16 January 1991: *Health and Safety Executive* by S. J. Banfield, Principal Inspector.

19 February 1991: *Fibre Access Network* by P. Allen, Manager, Access Division, BTUK.

19 March 1991: *Oswestry Network Operation Centre—TNO* by R. Groves.

North East Centre

Except where stated, all meetings will be held at the Neville Hall, Newcastle, commencing at 14.00 hours.

4 December 1990: *Telecommunications Networks—Matching Technology Push to Customer Pull* by Dr. D. Leakey, Chief Scientist, BT.

5 February 1991: Forum for Local Papers.

6 March 1991: *External Plant Research at Martlesham* by J. Haley, T. Leaver and A. Warner, British Telecom Research Laboratories.

9 April 1991: Forum for Local Papers.

Northern Ireland Centre

Except where stated, all meetings will be held at the BTNI Business Centre, Dial House, Belfast, commencing at 12.00 hours.

14 November 1990: *District Network Management* by G. Gettinby, British Telecom Northern Ireland.

5 December 1990: *The STAR Programme in Northern Ireland* by J. Russell, British Telecom Northern Ireland.

9 January 1991: *SCOUR* by R. Alexander, British Telecom Northern Ireland.

6 February 1991: *Site Visit to Royston House* by C. Moore, British Telecom Research and Technology.

6 March 1991: *Worldwide Network Organisation* by A. Kane, Director, Operations (North), Worldwide Networks.

Severnside Centre

Except where stated, all meeting will be held at Nova House, Bristol, commencing at 14.15 hours.

6 February 1991: *Personal Communications* by T. Legood, Customer Service Manager, Wales and West.

6 March 1991: *Business Communications* by D. Knowles, Customer Service Manager Midlands, Wales and West.

3 April 1991: *Derived Services—The Evolving Network* by K. Tabor, Networks Operations Support Manager.

South Downs Centre

All meetings will be held at the Lecture Theatre, Central Library, Richmond Road, Worthing, commencing at 12.45 hours. Refreshments from 12.00.

13 November 1990: Two Lectures: *Timberlined Tunnels* by J. Wallis, South Downs External Contracts Manager; and *Visibly under Control* by A. Yates, South Downs Project Office Manager.

11 December 1990: *Major Customer's Needs—A Customer's Viewpoint* by P. Smith, Manager, Communications Services, Sun Alliance.

8 January 1991: *BT Marine* by R. Struzyna, General Manager Technology, BT Marine.

12 February 1991: Two Lectures: *Synthesised Speech Systems* by P. Martin, South Downs Manager Test Equipment Design Centre; and *South Downs Faces its Public* by K. Hick, South Downs Public and Media Relations Manager.

19 March 1991: *BT's Strategic Direction* by R. Marriott, Director Corporate Strategy.

West Midlands North Centre

Meetings will be held at British Telecom Technical College, Stone.

19 November 1990: *Telecommunications Network—The Next Decade* by Dr. D. M. Leakey, Chief Scientist, BT. Commences at 13.45 hours.

10 December 1990: Combined IEE/IBTE Lecture: *Solar Energy and its Applications* by Prof. D. Hill, President UK Solar Energy Society. Commences at 18.00 hours.

21 January 1991: *The Challenge of the 90s* by L. Stanage, Director Operations, CSWE & W. Commences at 13.45 hours.

26 February 1991: *A Glimpse of the Future* by Dr. T. Rowbotham, Director Networks Technology, British Telecom Research Laboratories. Commences at 13.45 hours.

11 March 1991: *What will be my role in 1992?* by Marion McCrindle, Customer Systems—Commercial Unit. Commences at 13.45 hours.

West Midlands South Centre

14 November 1990: *Coventry Cable TV* by M. Wall and M. Preedy, BT Coventry Cable. To be held in 3rd Floor Conference Room, The Telecom Centre, Little Park Street Coventry. Commences at 19.00 hours. Refreshments from 18.30 hours.

4 December 1990: Faraday Lecture: *Lodestones to Load Carriers* by Universities of Bath and Essex. To be held at the Arts Centre, University of Warwick Coventry. Afternoon/evening lectures by ticket only. For further information contact Local-Centre Secretary.

Westward Centre

All meetings will commence at 12.00pm with refreshments

13 February 1991: *Energy on the Network* by S. Long, Westward District Power and Building Engineering Service Manager. To be held in the Board Room, Telephone House, Plymouth.

13 March 1991: *The Challenge of the 90s* by L. Stannage, Operation Director Worldwide Networks South. To be held in Conference Room, Exbridge House, Exeter.

Yorkshire and Lincolnshire Centre

22 November 1990: *The North East NOU* by R. S. M. Tranto. To be held at the Congreve Room, West Yorkshire Playhouse, Leeds. Commences at 13.00 hours.

LOCAL-CENTRE SECRETARIES

The following is a list of Local-Centre Secretaries, to whom enquiries about the Institution should be addressed.

Centre	*Local Secretary*	*Address and Telephone Number*
Aberdeen	Mr. A. T. Mutch	British Telecom, D2.2.4 New Telecom House, 73–77 College Street, Aberdeen AB9 1AR. Tel: (0224) 753343.
East Anglia	Mr. T. W. Birdseye	East Anglia District NL1.5.3, Telephone House, 45 Victoria Avenue, Southend-on-Sea, Essex SS2 6BA. Tel: (0702) 373337.
East Midlands	Mr. D. H. Bostrom	IO4, 200 Charles Street, Leicester LE1 1BA. Tel: (0533) 534212.
East of Scotland	Mr. G. Neilson	British Telecom East of Scotland District, NS65, Telephone House, 357 Gorgie Road, Edinburgh EH11 2RP. Tel: 031–345 3441.
Lancs and Cumbria	Mr. A. J. Oxley	SM4, BMC, North Street, Preston PR1 1BA. Tel: 0772 265419.
Liverpool	Mr. D. Bowe	British Telecom Liverpool District, EN42, 3rd Floor, Royal ATE, 100 Wood Street, Liverpool L1 4DH. Tel: 051– 229 3723.
London	Mr. A. Oodan	British Telecom, NSET6.1.3, Room 445, Williams National House, 11-13 Holborn Viaduct, London EC1A 2AT. Tel: 071– 356 9191.
Manchester	Mr. J. M. Asquith	British Telecom, NE20, Irwell House, 19 Chapel Street, Salford M3 7BA. Tel: 061–600 5171.
Martlesham Heath	Mr. M. Shaw	RT5241, MLB/3/50, British Telecom Research Laboratories, Martlesham Heath, Ipswich IP5 7RE. Tel: (0473) 645594.
North Downs and Weald	Mr. N. Smith	British Telecom, NP4, Telephone House, Rheims Way, Canterbury, Kent CT1 3BA. Tel: (0227) 474594.
North East	Mr. P. L. Barrett	British Telecom North East, EP38, Swan House, 157 Pilgrim Street, Newcastle-upon-Tyne NE1 1BA. Tel: 091–261 3178.
North Wales and the Marches	Mr. P. C. Clay	N4.4.3, Communication House, Harlescott Lane, Shrewsbury SY1 3AQ. Tel: (0743) 274353.
Northern Ireland	Mr. D. S. Elliott	BTNI/ND26, Churchill House, 20 Victoria Square, Belfast BT1 4BA. Tel: (0232) 240353.
Severnside	Mr. I. Davies	EP58, Telephone House, Queen Charlotte Street, Bristol BS1 1BA. Tel: (0272) 206701.
Solent	Mr. D. Henshall	BE33, Solent District Office, Telephone House, 70–75 High Street, Southampton SO9 1BB. Tel: (0703) 823421.
South Downs	Mr. C. J. Mayhew	British Telecom South Downs District Office, ED8, Grenville House, 52 Churchill Square, Brighton, BN1 2ER. Tel: (0273) 225030.
South Midlands	Mr. J. Coley	British Telcom, LN115, Telephone House, 25–27 St. Johns Street, Bedford MK42 0BA. Tel: (0234) 274849.
South Wales	Mr. P. F. Coleman	British Telecom South Wales, District Engineering Office, WP6, 25 Pendywallt Road, Coryton, Cardiff CF4 7YR. Tel: (0222) 691622.
Thameswey	Mr. R. D. Hooker	Thameswey District Head Office, DN4.3, Telecom House, 49 Friar Street, Reading, Berkshire RG1 1BA. Tel: (0734) 501754.
West Midlands (North)	Mr. R. J. Piper	c/o Mr. P. L. Field, BT Technical College, Stone, Staffordshire ST15 0NL. Tel: (0785) 813483.
West Midlands (South)	Mr. G. R. Chattaway	British Telecom, WMD/EME24, Telecom Centre, Little Park Street, Coventry CV1 2JY. Tel: (0203) 228396.
West of Scotland	Mr. L. M. Shand	TSO/S1.3.6, Dial House, Bishop Street, Glasgow G3 8UE. Tel: 041–221 1585.
Westward	Mr. R. Rand	British Telecom, NP2, Exbridge House, Commercial Road, Exeter EX2 4BB. Tel: (0392) 212681.
Yorkshire and Lincolnshire	Mr. S. Wood	SO14, Bradford CTE, Sharpe Street, Bradford BD5 0QJ. Tel: (0274) 375950.

ASSOCIATE SECTION INTER-DISTRICT COMMITTEE CONTACT POINTS

The following is a list of Associate Section Inter-District Committee contact points to whom enquiries about the Associate Section should be addressed.

Inter-District Committee	*Contact*	*Telephone Number*
East	Mr. T. Turner	(0345) 333111 (pager no. 0774759)
London	Mr. J. Tythe	081–804 2400 Extn. 347
Midlands	Mr. J. Sansom	(0604) 35999
North East	Mr. K. Whalley	(0642) 310937
North West	Mr. R. Craig	(0772) 267236
Northern Ireland	Mr. R Gamble	(0232) 621421
Scotland	Mr. K. McMonagle	041–220 3552
South East	Mr. M. Harvey	(0424) 435437
South West	Mr. J. R. Dymott	(0202) 206497
Wales	Mr. F. Brown	(0952) 49886

Journal Award Scheme

British Telecommunications Engineering is an important record by which the membership of the Institution of British Telecommunications Engineers (IBTE) and others can keep abreast of the various items of interest in telecommunications engineering.

To encourage the readers in furthering the role of the *Journal*, and to give authors due recognition for an outstanding contribution, the Board of Editors has introduced an award scheme. Prizes will be awarded to the authors of papers which, in the opinion of the Board, demonstrate excellence in content and presentation and which enhance the quality and range of contributons published. Each year, a prize will be awarded for the best article published in a complete volume, together with a number of prizes for runners-up.

To initiate the scheme, the Board of Editors has reviewed all the articles in Volume 8 of the *Journal*, spanning the four issues from April 1989 to January 1990, and has awarded prizes to the authors of four articles. The authors received their prizes from Dr. Alan Rudge, the Institution's new President, at a special reception held on 26 September 1990 at the BT Marketing Prototype Centre in London.

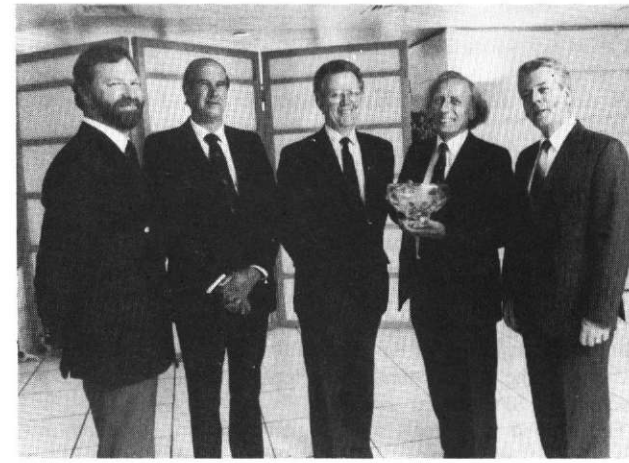
The prize for the best overall paper went to Don Clow for his article 'Rising Groundwater in Urban Areas—Implications for British Telecom'. Mr. Clow received a crystal bowl inscribed with the IBTE's insignia and a cheque for £250.

His article described the results of a study into the effects of the reduction of abstraction of water from beneath London which is causing groundwater levels to rise rapidly towards the natural level. This rise could have undesirable consequences on buildings, tunnels and underground ducts and jointing chambers. The article outlined the reasons for the changes in groundwater level and made a preliminary assessment of the effect on structures.

Mr. Clow, a Head of Section in the Power, External Plant and Cable TV Division of BTUK dealing with the civil engineering aspects of BT's underground network, has written several articles for the *Journal* during his career. He has been collecting together a complete set of back issues of *The Post Office Electrical Engineers' Journal* and *British Telecommunications Engineering* from the first issue in April 1908. The opportunity was taken to present Mr. Clow with the one remaining issue to complete his collection.

Three runner-up prizes were awarded comprising glass paperweights inscribed with the IBTE's insignia, together with cash awards of £50.

John Bowen received a runner-up prize for his article 'Main Distribution Frames' published in the April 1989 issue. Mr. Bowen's article examined the requirements for distribution frames together with their applications. Before his retirement from BT earlier this year, Mr. Bowen was with BT Fulcrum assisting with the launch and technical support for the COSMIC family of modular distribution frames.



Authors at the *Journal*'s award ceremony pictured with Colin Shurrock (centre), Chairman of Council, IBTE

(Left to right: Dennis Crowe, John Bowen, Colin Shurrock, Don Clow, and Alistair McLeod)

The second runner-up prize was awarded to a team of four authors, Ivan Boyd, Chris Southcott, Dennis Crowe and Peter Bolingbroke, for their article 'Speech Codec for the Skyphone Aeronautical Telephone Service' in the July 1989 issue. Their article gave a brief description of the Skyphone aeronautical telephone service, and the factors which influence the speech codec design, and described the codec designed by British Telecom Research Laboratories (BTRL) which was selected from various speech codecs proposed by companies from several different countries for use in the service.

Ivan Boyd is a Head of Group in the Speech and Language Processing Division of BTRL working on research into low-bit-rate speech coding. Chris Southcott heads a section at BTRL researching speech analysis, speech synthesis and speech coding. Dennis Crowe works in a network modelling group at BTRL, specialising in the development of quality assessment methods for low-bit-rate codecs. Peter Bolingbroke, from British Telecom International, is involved with the systems engineering of BT's mobile satellite services, and has been involved from the outset with the technical development of the Skyphone system.

Finally, Alistair McLeod, Head of Section in the Network Engineering and Standards Division, BTUK, responsible for numbering policy and standards, received a runner-up prize for his article 'Numbering in Telecommunications' published in the January 1990 issue. His article reviewed the application of numbering in telecommunications networks, considering in particular the influences on the evolution of the numbering plan for the switched telephony service.

Book Reviews

SPC Digital Telephone Exchanges

F. J. Redmill, and A. R. Valdar.
Peter Peregrinus. xi+497 pp. 230 ills. £55·00.
ISBN 0−86341−147−9.

This book contains an excellent treatment of stored- program control (SPC) digital telephone exchanges set within the context of modern telephony, and positioning the exchange as an integral part of the network. It is logically structured in four main parts, building on the foundations of the first part which deals with the fundamentals of telephony and introduces the concepts of SPC digital switching.

The second part deals with digital switching in depth not only dealing with system and architecture, but also including aspects influenced by the network, such as the customer and network line interfaces, how signalling is handled and network synchronisation. The authors admit that there is no standard architecture for digital exchanges but usefully describe the main differences between most of the major manufacturers' current systems.

The stored program control of digital exchanges is given exhaustive treatment in the third part of the book. The coverage ranges from data structures to the various software functions and how they are translated into software processes including the use of the specification and description language for the design of software. Important issues of software reliability, maintainability and management are also dealt with.

The last part of the book recognises that the main advantages of digital switching occur when integrated in a digital transmission environment using common-channel interprocessor signalling as an integrated digital network. It therefore contains useful information on network and operational aspects including network control, the common network and access signalling systems, planning considerations and the integrated services digital network (ISDN) with its use for new services.

Overall a well written book which provides a useful introduction to SPC digital switching for the novice but, for the informed reader, is a good source of detail on the topic with comprehensive references supporting each chapter for more exhaustive research. The relationship between the switch and network is particularly well addressed. It has a readable style of presentation which guides the reader logically through the contents, each chapter having an introductory section that describes its contents and positioning within the structure of the book.

Although giving the reader a tantalising glimpse of how digital switching may develop within the context of the intelligent network and variable-bit-rate switching using ATM techniques, the book would be more rounded had these topics been explored in more depth. Supplementing the network management description in terms of standard architectural models such as ONA-M and more detailed treatment of exchange dimensioning would also have been beneficial. However, the book contains firm and enduring foundations for exploring these issues and is a worthy successor to 'Herbert and Proctor' and 'Atkinson' as a standard switching text.

K. E. WARD

Editorial Note: This book is available on loan from the IBTE Library.

Telecommunications Engineering (second edition)

J. Dunlop, and D. G. Smith.
Van Nostrant Reinhold (International), xix+508 pp. 319 ills. £16·95.
ISBN 0−278−00082−7.

The first edition of this textbook, published in 1984, was intended to provide a broader than normal overview of telecommunications engineering, both for undergraduate students who will not need to delve deeper, and as a firm foundation for telecommunication specialists. The second edition maintains these objectives, while updating the coverage of digital signalling and telephony, adding coverage of packet switching networks and satellite communications, and correcting minor errors elsewhere. The reader is assumed to know at least the basic concepts of electronic engineering, electromagnetic theory, probability theory and differential calculus.

The book is well designed, with clear text and illustrations, and has an extensive contents list which refers to both chapters and sub-chapters. Abbreviations are explained in the text when they are first encountered. Its 14 chapters cover the following topics: signals and channels, analogue modulation theory, discrete signals, noise in analogue and digital communication systems, high-frequency transmission lines, antennas, active and passive microwave devices, telephony, television systems, optical-fibre communications, packet switched networks, and satellite communications.

Each chapter relies heavily on mathematical formulae to define the performance of the circuitry being described, and concludes with a brief synopsis and a selection of problems and answers.

Despite the wide-ranging coverage, there are still some surprising omissions. For example, no mention is made of stereo broadcasting (radio or television), satellite broadcasting, high-definition television, customers' telecommunications equipment such as PABXs, telephones or facsimile machines, the Telex network, radiopaging network, packet switching systems, or the integrated services digital network, while the digital cellular radio network is only described briefly as a future system with many technical problems.

Inevitably, in a book of this nature, a specialist will accuse the authors of perpetrating minor errors within his subject of expertise. In my case, I noticed that the telephony chapter quotes GSCs, DSCs and MSCs as current UK terminology, that the explanatory call set-up sequence gives number unobtainable tone rather than equipment engaged tone on failing to find a free switching path, and that the call clears down when the called party clears rather than the calling party. However, this does not seriously damage its overall worth as an undergraduate's set book.

Despite the extensive mathematical treatment, the book provides an excellent reference book to modern telecommunications technology.

C. J. J. EVANS

IBTE Business Game

On 1 October, information to enable work to begin on Stage 1 of the first IBTE Business Game was sent to Local-Centre Secretaries.

More than 75 teams have been entered for the first stage, which requires the team to produce a strategy paper describing how they propose to meet the telecommunications needs of 'Utopia', the subject of all stages of the game. These strategies will be evaluated by the Local Centres, and a winner and runners-up for each Centre will be advised to the game manager, Len Weller.

Each Centre winner and a number of the best runners-up will then progress to the next stage, which is to produce, by means of computer simulation, a plan to build/modernise a network to serve Utopia. This stage will commence in the first week of November. Unfortunately, it has not proved possible to support more than 30 teams in the second and third stages of the game, so a number of teams will have to fail at the first hurdle. Our thanks and commiserations go to those who prove unsuccessful—we hope they will try again next year.

The date for completion of Stage 2 will be by 20 December, at which point each team will submit to the game manager a Financial Authorisation Committee (FAC) paper—a submission for financial authority to build the network for Utopia. This will be accompanied by a copy of the computer data disc.

Stage 3 then commences with 'FAC agreement', published on 25 January, after which the teams will adopt the roles of directors of the company and run the business, again by computer simulation, for a number of 'years'. The performance of the teams will be judged on their ability to meet business targets, deliver an acceptable quality of service while achieving the best possible share price. The three most successful teams will then be invited to London to present director's reports to the 'company's AGM' and answer questions from a panel of experts, which we hope will include Mike Bett.

Performance in each stage of the game, together with performance at the 'AGM' will determine first, second and third places. The three teams will then be invited to attend the IBTE Dinner on 29 May 1991, where they will receive their awards.

JON INCHLEY
IBTE Secretary

Notes and Comments

INCREASE IN SUBSCRIPTION RATES—EXTERNAL CUSTOMERS

As previously announced with the FITCE Congress special issue of the *Journal*, the subscription rates for the *Journal* to external customers (that is, not employees of British Telecom or The Post Office) will increase from the January 1991 issue. However, the postage and packaging elements of the new rates previously quoted have been reviewed and revised downwards. The new rates are: price per copy: £2·50 (£3·00 including postage and packaging UK; £4·00 including postage and packaging overseas); one year's subscription: £12·00, UK; £16·00 overseas. Overseas customers can pay by sterling drafts drawn on London. Because of high bank charges, payments in US dollars cannot be accepted.

CONTRIBUTIONS TO THE JOURNAL

Contributions of articles to *British Telecommunications Engineering* are always welcome. Anyone who feels that he or she could contribute an article (either short or long) of technical, managerial or general interest to engineers in British Telecom and the Post Office is invited to contact the editors at the address given below. The editors will always be pleased to give advice and try to arrange for help with the preparation of an article if needed.

Guidance for Authors

Some guidance notes are available to authors to help them prepare *Journal* articles in a way that will assist in the uniformity of presentation, simplify the work of the *Journal*'s editors, printers and illustrators, and help ensure that authors' wishes are easily interpreted. Any author preparing an article is invited to write to the Editorial Office, at the address given below, to obtain a copy.

All contributions to the *Journal* must be typed on one side only of each sheet of paper, or they can be submitted on IBM-compatible disc. As a guide, there are about 750 words to a page, allowing for illustrations, and the average length of an article is about six pages, although shorter articles are welcome. Contributions should preferably be illustrated with photographs, diagrams or sketches. Each diagram or sketch should be drawn on a separate sheet of paper; neat sketches are all that is required. Photographs should be clear and sharply focused. Prints should preferably be glossy and should be unmounted, any notes or captions being written on a separate sheet of paper. Good colour slides can be accepted for black-and-white reproduction. Negatives are not required.

It is important that approval for publication is given at organisational level 5, and authors should seek approval, through supervising officers if appropriate, before submitting articles.

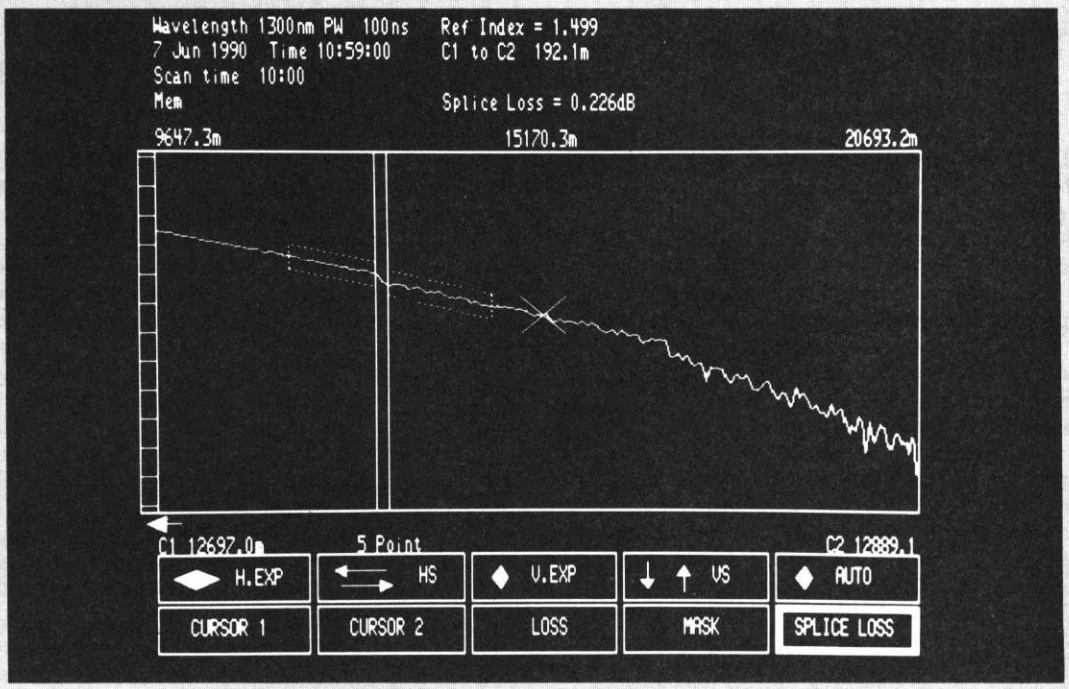
JOURNAL DISTRIBUTION—NOTIFICATION OF CHANGES OF ADDRESS

IBTE Members and *Journal* subscribers who change their home address should ensure that they notify the *Journal* office on the address-label slip provided with every copy of the *Journal*.

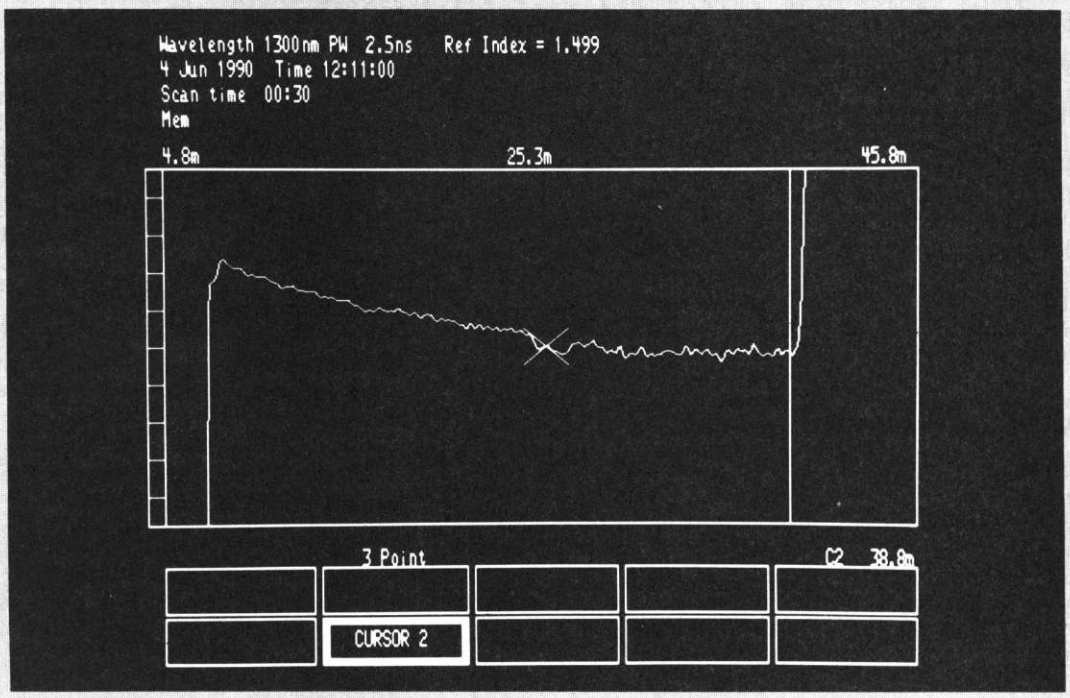
All enquires related to distribution of the *Journal* should be directed to The Administration Manager at the address given below.

BTE JOURNAL/IBTE ADMINISTRATION OFFICE

All correspondence and enquires relating to editorial matters ('letters to the editor, submissions of articles, requests for authors' notes etc.) and distribution of the *Journal* should be sent to: *BTE Journal* Editorial Office/IBTE Administration Office, 2–12 Gresham Street, London EC2V 7AG. (Telephone: 071–356 8050.)



The Long & the Short of it.



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(Founded as the Institution of Post Office Electrical Engineers in 1906)

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The object of the Institution of British Telecommunications Engineers is to advance the electrical and telecommunications sciences and their application, and facilitate the exchange of information on these and allied subjects.

ELIGIBILITY There are two classes of Corporate Membership (full definitions are given in Rules 5 and 6):

Member British Telecom (BT) staff in the Management and Professional Group (MPG), and senior management grades, who are or have been directly involved in the engineering, or scientific or technical work of BT, and equivalent Post Office (PO) staff.

Affiliated Member BT staff in the MPG of MPG1 and above whose work is associated with that of Members, and equivalent PO staff.

Other engineering staff in BT and the PO may be eligible to join the Associate Section. Further details of the Associate Section can be obtained from local contact points.

MEETINGS keep Members informed on technical and related aspects of the work of BT and the PO and offer the opportunity for discussion. Details are given in the Centre programme. Members are entitled to claim official travel expenses from their headquarters to the meetings. Copies of papers read at the meetings are published locally and in selected instances nationally.

JOURNAL Each Member is supplied with a free copy of the quarterly *British Telecommunications Engineering*, a technical publication which is highly regarded worldwide by postal and telecommunications engineers. The *Journal* is sent to Members' home addresses.

VISITS are arranged to (BT/PO) installations and to outside businesses and other concerns of interest to Members.

LIBRARY The Institution's lending library comprises 2000 books on scientific, technical and administrative subjects which can be borrowed free of charge via the official post. Books can be loaned for a maximum period of three months unless wanted earlier by another Member; the simultaneous loan of two or more books is permitted at the Librarian's discretion.

SUBSCRIPTION The annual subscription, payable from 1 April each year, is £6.60. The preferred method of collection is by monthly deduction from salary, for which both parts of the form printed below must be completed. Subscriptions are allowable against Income Tax — quote reference CI/SUB/459.

THE FEDERATION OF TELECOMMUNICATIONS ENGINEERS OF THE EUROPEAN COMMUNITY (FITCE) Membership of FITCE is open to IBTE Members who have a University Science degree or are Chartered Engineers. Please tick the appropriate box on the form for details.

APPLICATION FORM

To: IBTE Administration Manager,
IBTE Administration Office,
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Duty reference and official address .....

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THE INSTITUTION OF BRITISH TELECOMMUNICATIONS ENGINEERS

(Founded as the Institution of Post Office Electrical Engineers in 1906)

MEMBERSHIP OF
THE FEDERATION OF THE TELECOMMUNICATIONS ENGINEERS OF THE EUROPEAN COMMUNITY

FITCE is an organisation of national associations with similar objectives to IBTE and draws its members from the public telecommunications administrations of Belgium, Denmark, Eire, France, Greece, Italy, Luxemburg, the Netherlands, Portugal, Spain, the United Kingdom and West Germany. FITCE sponsors multi-national study groups (Commissions) to enquire into and report on problems of general interest, and each year one of the member countries hosts a General Assembly/Congress at which a given technical theme is discussed.

IBTE is the sole representative body for the United Kingdom membership, having been accepted into the Federation in 1981. An IBTE Member, on joining FITCE, will become a Member of the FITCE Group of IBTE. FITCE Group activities are subject to the Institution's rules, but only the Group Members have voting rights on any rules which are exclusively concerned with FITCE Group affairs. A FITCE Group Member will be eligible for selection to serve on FITCE Commissions or to become an official delegate to (or attend unofficially at own expense) General Assemblies/Congresses in accordance with FITCE Rules.

The Membership of FITCE is available to Members and Affiliated Members of IBTE who hold a University Science Degree and/or are Corporate Members of the Chartered Engineering Institutions and/or are Chartered Engineers.

APPLICATION FOR MEMBERSHIP OF THE FITCE GROUP OF IBTE

Assistant Secretary, IBTE/FITCE Group
BTUK/NPW8.1.3, 2C3, The Angel Centre, 403 St John Street, London EC1V 4PL

I wish to become a member of FITCE through the FITCE Group of IBTE and enclose a cheque for £5·00, made payable to IBTE, in payment of my subscription to 31 March 19____. My qualifications are as follows:

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Your application for membership of the FITCE Group has been accepted. Your name and address will be forwarded to the FITCE Secretariat. Please advise of any change of address in writing.

Date _____ Signed _____ Asst. Sec, IBTE/FITCE

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